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WATER SUPPLY OF STATEN ISLAND

Results of Investigation of Committee Appointed by Mayor in 1905—Topography, Sources of Supply and Pumping Stations—Value of Plants

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THE subject of New York water supply has occupied so much space and has been given such considerable attention in the daily and technical press of recent period, that it would seem all relative points of interest had been fully covered. While all surrounding and neighboring systems and sources of supply have been discussed, there is one, the Richmond Borough water supply, however, which has escaped general attention. A description of this system may be of interest at the present period through the fact that a situation has been reached where the borough has been caused to question the limit of its present sources and to consider the future requirements and the means to meet them. Because of this uncertainty a committee was appointed by the Mayor in May, 1905, to investigate this Richmond water supply, and at the same time to prepare a fixed valuation on the separate private plants in view of the purchase of the same by the city. The results of this investigation, which have been but recently presented, have been a gathering together of data which should be of interest to the engineering and municipal world.

STATEN ISLAND—TOPOGRAPHY AND GEOLOGY

Topographically, Staten Island comprises a region of hills and plains combined. Extending from St. George to Richmond, northeast and southwest, a range of hills divides the island into two distinct portions. These hills rise to an altitude of over 400 feet at the highest point and are of elevations averaging between 250 and 300 feet throughout the greater part of their course. East of this ridge, extending to New York Bay, lies a broad plain averaging in elevation about 20 feet, and in some places very uniformly level. On the west side of these hills the country is very irregular, but slopes generally in a northwesterly direction to the Kill von Kull.

STATEN ISLAND, N. Y., WATER SUPPLY—BROOK'S POND

The water sources used by the private water companies of Staten Island include areas on both sides of this ridge of hills. Extending from Port Richmond to Linoleumville, northeast and southwest, is a formation of trap rock. This is the actual continuation of the Hudson river palisades. The ridge described between St. George and Richmond is underlaid with serpentine rock. These two rock formations inclose a valley which constitutes a source of the greater part of the Staten Island water supply, the ground water being intercepted by these rock formations within this area. The soil of this territory is composed generally of vegetable mold and clay to a depth of 40 or 50 feet, underlaid with sand or gravel, while below this is generally found another bed of very hard clay. The plain region east of the ridge of hills mentioned has been tapped by the water companies in several places, but has not yet been investigated to its full extent. On the extreme southern end of the island the city already operates a pumping station and supplies water within a limited district.

Sources of Water Supply

There are three private Water Supply Companies operating in Staten Island, viz., the Staten Island Water Supply Company, the Crystal Water Company, and the South Shore Water Works Company. They obtain their supply from eight different sources. Actual operations were commenced by these companies in 1881, 1884, and 1889, respectively. Previous to the construction of these plants the inhabitants had been supplied with water from wells and springs, which in very dry weather reached very low capacities, and water at these times was very scarce and expensive.

The Staten Island Water Supply Company

The Staten Island Water Supply Company supplies the northwestern portion of the island from St. George to Port Richmond and outlying districts. It was incorporated in 1878, and in 1881 had laid the first fifteen miles of pipe and established its first pumping station at West Brighton, deriving its supply from three six-inch driven wells. At present it has four distinct pumping stations in operation. A total number of 272 driven wells have been sunk and about 75 miles of cast-iron pipe have been laid. There is no indication, in the present arrangement of their distribution system, of a very systematic pre-arranged plan of development, but rather there are shown conditions arrived at through meeting the actual needs of the various communities from time to time. This has been caused by the uncertainties and vagaries encountered in the development of such a place as Staten Island, which has progressed more slowly and erratically than its neighboring boroughs owing chiefly to improper transportation facilities and the building up of certain localities followed by a corresponding decadence of others. At the beginning of the Water Companies' service, the Rapid Transit railroad had not been built and the ferries ran at hourly intervals only. It may be said that the inhabitants of Staten Island during this period consisted chiefly of the wealthy owners of suburban estates, and of those to whom the cheapness of property and living appealed, regardless of distance from New York.

The growth of the Island has been sure, however, and the present conditions warrant the use of all possible means by which the Water Companies may increase the capacities of their plants.

The pumping stations operated by the Staten Island Water Supply Company are named and located as follows:—

1. West Brighton Station, in the Town of West New Brighton, near the shores of the Kill von Kull.

2. Springville Station, in New Springville, near the head of the Fresh Kills.

STATEN ISLAND, N. Y., WATER SUPPLY—WELL SYSTEM, BULL'S HEAD PUMPING STATION

3. Bull's Head Station, in the section known as Bull's Head.

4. Brighton Heights Station, on the heights back of the Sailor's Snug Harbor Estate.

West Brighton Pumping Station.—The source of the West Brighton supply is confined to the water sheds known as the Clove Valley and Palmer's Run, included in the territory previously mentioned, between the serpentine ridge and the palisade trap rock. This water course is directed toward the pumping station, flowing under a chain of lakes marking the lowest depressions between the surrounding hills governing the water shed. It is intercepted by the wells at this pumping station.

There are at present 155 driven wells at this station, averaging from 80 to 135 feet in depth. These are flowing wells, and they are arranged in separate groups. The well points are made of perforated iron pipe 9 feet long, protected by two layers of wire screen, separated from each other and the pipe by ¼-inch wire wound spirally. This prevents sand from washing in and affecting the pump plungers. The water from these wells is collected through main branches and led directly to a receiving well 15 feet in diameter and 22 feet deep. To prevent any irregularity in the flow from the wells to the receiving well, a vacuum pump is connected to these well lines. It is so provided that if the vacuum is broken the air line of each group of wells can be shut off without stopping the pump. The suction piping is arranged so that pumping can be directed from the driven wells to the pumps in case it is necessary to shut off the receiving well.

Three pumping engines and four boilers are maintained at this plant. The Holly pump is the only item of particular interest. It is a horizontal, compound condensing crank and fly-wheel pumping engine, having a daily capacity of 5,000,000 gallons and a rated duty of 100,000,000 ft. lbs. Steam cylinders are 42 inches in diameter, stroke 36 inches. The pump plungers are double acting, 19½ inches in diameter. The main crank shaft is 10 inches in diameter, and fly wheel 13 ft. 4 in. The engine pistons are of the "Ring" type. The engines are so arranged that they may be operated so that either pair of high or low pressure cylinders, and its connecting pump, can be used independently of the other steam cylinders and pump. There are four air pumps, engine driven, and four single-acting feed pumps, engine driven. The hot water from the condenser is delivered to a hot well under the floor of the engine room, and from there pumped to the boiler. Two Knowles pumps, of very ancient type, are used as auxiliaries when it is necessary to overhaul the Holly pump.

As this is the oldest pumping station of the company, the other machinery is not of very modern type, and therefore hardly worthy of description. In driving the last group of wells on this property it is likely that the first stratum of hard pan was pierced, and the wells driven to a deeper bed. This has been assumed to be the case because of the salty character of the water obtained from these wells. The taste has not been affected to any great extent, but the boilers have suffered considerably throughout the community, and it has been necessary to suspend this part of the supply. The wells and a great portion of the water shed lie in a district which is rather thickly populated and which is rapidly building up; therefore the water suffers considerable pollution, although it has not yet reached a dangerous stage.

Springville Pumping Station.—The Springville station was built in 1900 and is comparatively new. The water shed comprises a portion of the territory southwest of the Clove Valley, and the pumping station is set at an elevation very close to sea level, and not far from the ridge of the palisade trap rock, which outcrops in this vicinity. The wells are 36 in number and 4 inches in diameter. Their depth averages about 75 feet. They are arranged in five groups, and are flowing, the pumps being directly connected to same. Two Worthington horizontal triple-expansion condensing pumping engines and two horizontal 150-horsepower boilers are maintained at this station, although only one set of engine and boiler are in general operation. Each pump has a daily capacity of 1½ million gallons and is rated at 75 million ft. lbs. duty. Size of pumps, 9-14-22-9½-18.

Bull's Head Pumping Station.—The water shed from which source the Bull's Head station is supplied is contiguous with that of Springville. The sub-surface flow is west to the company's property, where it comes near the surface because it is stopped by the trap rock lying some distance further. The surface indications point to four separate water sheds from the surrounding hills centering on the company's property. Seventy-five 4-inch wells have been sunk at this place, averaging about 70 feet in depth, but are not flowing, the water standing about twelve feet from the surface when the pumps are not running. Thirty feet of 2½-inch suction pipe extends into each of the wells, which are left open on the top, this pipe being connected directly with the suction main to the pumps, the atmospheric pressure thus helping to lift the water after a vacuum has been created in the main. The wells are arranged in four separate lines, two to the right and two to the left of the suction main and parallel to each other. The average distance between wells is about 30 feet. Each well and gate is covered by a well-box (see illustration), which is about five feet square, of 4 x 6-inch spruce, sheathed with 3 x 10-inch tongued and grooved yellow pine. These boxes are carried to a depth of about 9 feet, at which depth the pipe is laid connecting with the wells, this depth being taken to save as much friction and lift as possible. These give ready access to the well connections. Two pumps and two boilers are maintained here.

An object of engineering interest is the Heisler high-duty triple-expansion pump, one of the first to be installed in the Eastern territory. It has a daily capacity of 2 million gallons, size 18-28-48-10½-24, and is rated for a duty of 100 million foot pounds. This pump has two compensating bars, one on each side, instead of the usual fly wheel. This fixes the length of stroke. The suction and discharge valves are vertical, thus allowing sand to wash clear of the plungers. Twelve steam expansions are guaranteed, and an indicated horsepower is developed on 18 pounds of steam when running at 100 million duty. The net opening area of each set of suction valves is not less than 130 per cent. of the plunger area. A surface condenser is placed on the discharge pipe and a single-acting condensing air-pump connected with same. A vacuum pump operates on two air chambers, one upon each suction pipe. Besides the Heisler pump, there is a small duplex Worthington pump in use as an auxiliary, having a capacity of about 600,000 gallons daily. There are two 150-horsepower boilers at this station.

Brighton Heights Pumping Station.—The Brighton Heights station was installed for the benefit of a real estate development which failed to mature, and now supplies only a few houses located in a district of high elevation. It is unimportant and derives its supply from five four-inch wells of 60 ft. depth. A small Worthington piston pump and a 50-horsepower boiler constitute the operating machinery.

The approximate daily pumping from the pumping stations which have been described is as follows: West Brighton, 3 to 5 million gallons; Springville, 800,000 gallons; Bull's Head, 1½ to 2 million gallons; Brighton Heights, 150,000 gallons. The average pumping, of course, will reduce these figures considerably owing to the suspension of part of the West Brighton supply and the decreasing of some of the other supplies during different periods of the year.

A reservoir of 750,000 gallons' capacity is a further item of the company's property. This was built at the time of the installation of the works and is located on the top of the hill above St. George, known as Fort Hill. It is used chiefly as a balance valve for the system. All the water being pumped directly into the distribution mains, the surplus pumpage is directed into this reservoir, which is generally about two-thirds full. Its use is generally called for when a sudden draught upon this high section cannot be met sufficiently by the direct pumping through the mains.

Distribution System.—The 4-inch and 6-inch pipe in the distribution system of this company comprises about 85 per cent. of the total amount, the remaining sizes varying between 8-inch and 24-inch, with a total of about 75 miles of mains. There are 687 gates, varying from 4-inch to 16-inch, and 602 fire hydrants. There are 159 meters of various types and a few crane and drinking hydrants. The cost of laying all service connections is paid for by the consumers.

The Crystal Water Company

The Crystal Water Company supplies the northeastern and eastern portions of the Island and outlying territories. It was incorporated in 1883, and in the latter part of 1884 the works were completed and placed in operation. A pumping station was built at Bull's Head and 15 miles of

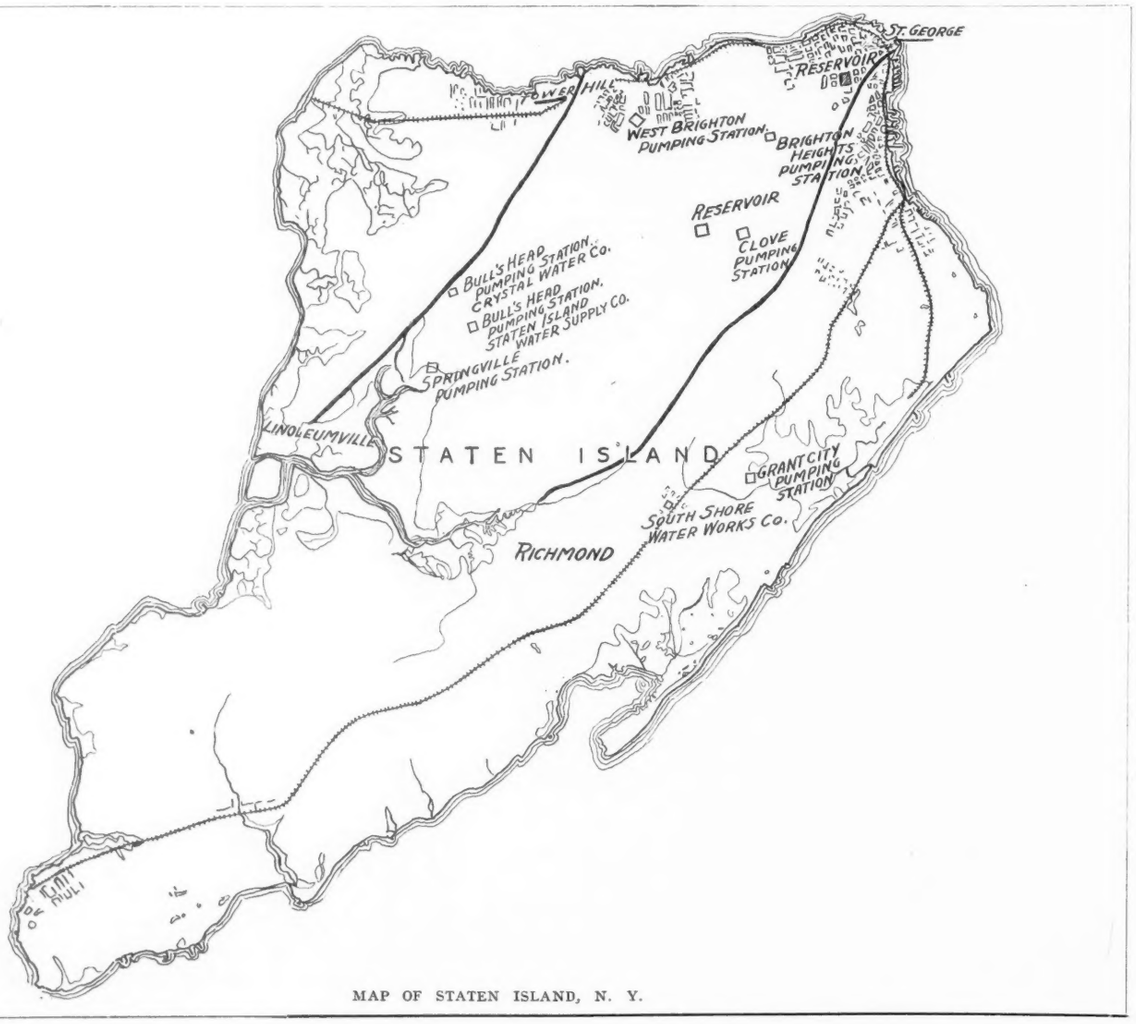
main laid. For high service a steel tank was erected on a plot of land of high elevation, about 420 feet, the capacity of same being about 100,000 gallons. This provided for adequate fire protection and furnished a supply for inhabitants living in districts of extreme elevation. The daily supply furnished by this plant was about 600,000 gallons and was sufficient to make feasible the construction of a reservoir to provide against emergency. This reservoir is located in the central portion of the Island at an elevation of 250 feet, is circular in shape and has a capacity of 4,000,000 gallons. It was constructed from excavation and embankment, the bottom and sides being covered with clay puddle and lined with vitrified brick.

The development of the portion of the Island in question was similar to that served by the Staten Island Water Supply Company, and the limit of the original source of supply was finally reached, so that up to the present time two more pumping stations and the necessary increase in the distribution system have been added to the company's resources. These are known as the Clove Pumping Station and the Grant City Pumping Station.

Bull's Head Pumping Station.—The original plant installed by this company is located at Bull's Head, in the valley between the serpentine ridge near the east shore and the palisade trap rock extending southerly from Port Richmond, the water shed previously mentioned. The Crystal Water Company was the first to explore this section and the Bull's Head station was located on a site appearing at that time the most favorable. Later developments, however, indicated that the arrangements could have been materially improved, as the wells now in use are located at extreme distances from the main pump house, and an auxiliary pump is required to deliver the water from the driven wells into a receiving well from which the pumping engine at the station delivers directly to the distribution system. The other engineering features of this station are unimportant. There are thirty-eight 5-inch wells averaging 60 feet in depth. This was an expensive plant to build, as little was known at that time of the nature of the soil and the experiments were often very costly. The two pumping engines in use at this station are a Deans and Knowles, respective capacities being 1,500,000 gallons daily and 1,000,000 gallons daily. There are two boilers at this station, horsepowers 100 and 65.

Clove Pumping Station.—The Clove pumping station was built in 1886, and is located at the head of the Clove Valley at an elevation of 136 feet. This is also on the west side of the main ridge of hills extending through the island and is about three miles east of the Bull's Head station, an intercepting hill forming this adjoining water shed. At present fifty-six 5-inch wells are in use, having average depths of about 70 feet. Cook well screens are fitted to the wells. Three pumping engines were installed at this station, two Deanes and one Worthington, having daily capacities of 2,000,000, 750,000, and 1,500,000 gallons, respectively. There are three boilers having horsepowers of 70 and 60. There are no particular features of interest at this station.

Grant City Station.—The Grant City station was built in 1904, and is located in a territory hitherto unused for water excepting by the works of the South Shore Company. When the urgent requirements for more water were encountered it was decided to tap the plain region east of the hills, and a site was chosen at Grant City, near Midland Beach. Little is known regarding the limit of the supply from this source. Five 4-inch and two 5-inch wells have been driven here, fitted with Cook well screens 10 feet long. This plant is operated by a Bethlehem power pump connected to a Hamilton-Corliss engine, power being transmitted by



MAP OF STATEN ISLAND, N. Y.

a 14-inch belt encircling a large fly wheel operating the pump plungers. The plungers of this pump move vertically. A daily pumping of 1,000,000 gallons is obtained. This type of pumping machinery is not in common use, but is said to furnish highly economical results, particularly noticeable in the saving of fuel. It is stated that the amount of work done by this pump may vary to a considerable extent, the percentage of efficiency and economy remaining practically the same. These conditions differ from those in most high-duty pumps, in that a change in the water pressure or in the amount of work done would result in a corresponding loss of economy in the steam end. In the Bethlehem pump everything is supposed to run smoothly, whether the speed from the connecting engine shaft is high or low. Another point in its favor is stated to be that its capacity may be increased within reasonable limits by exchanging the cylinders and plungers. There is a 100-horsepower boiler at this station.

The approximate daily pumping from the pumping stations which have been described is as follows: Bull's Head, 750,000 gallons; Clove, 1 to 2 million gallons; Grant City, 1,000,000 gallons.

Distribution System.—There are about 52 miles of mains in the distribution system of the Crystal Water Company, varying in sizes from 1-inch to 14-inch. About 12 per cent. is wrought iron pipe from 1 inch to 4 inches in diameter, 70 per cent. is 4-inch and 6-inch pipe, while the remaining sizes vary between 8-inch and 14-inch. A considerable amount of spiral riveted cement-lined pipe was laid during the earlier years of the company's operation, but most of this has been replaced by cast-iron pipe, and at present only about two miles of this spiral pipe is in use. There are 300 gates in the system, varying in size between 4-inch and 14-inch, and 453 fire hydrants. An extensive meter system is employed and about 2,200 meters have been set, although only 1,600 are in present use. In the case of this company, service connections are made at the company's expense. A few crane and drinking hydrants are also employed.

South Shore Water Company

The South Shore Water Company maintains a small plant for supplying the village of New Dorp on the east side of Staten Island. This village is the only portion of the Island between the works of the Crystal Company and the City plant at Tottenville, which is populated sufficiently to require the service of a water company.

The supply is obtained from two 8-inch driven wells 65 feet deep and the water is pumped direct to a steel standpipe 20 feet in diameter and 60 feet high; capacity, 140,000 gallons. There are two small Worthington piston pumps located at the bottom of a brick open well 25 feet deep, connected directly with the driven wells and delivering the water to the standpipe. The distribution mains are supplied directly from the standpipe. There is nothing of particular interest in this waterworks system, and in the event of a combination of the entire waterworks equipment on the Island, the mains are all that would be of any permanent value. There are 111 taps in the system and about two and one-half miles of pipe of sizes varying from 2-inch to 6-inch.

Present Capacity of Plants and Water Sheds

The City Commission has figured that the water sheds of the private water companies comprise the following drainage areas: West Brighton, 3.17 sq. miles; Bull's Head, 0.61 sq. miles; Springville, 0.89 sq. miles; Clove, 1.30 sq. miles; Bull's Head (C. W. Co.), 2.45 sq. miles; Grant City, 1.78 sq. miles. In three of these cases the drainage areas are so intermingled that it is difficult to ascertain just which pumping stations control the bulk of the water in this district. However, the total area would remain the same.

It has been estimated by an experienced waterworks engineer who has made a careful study of the sources of Staten Island water supply that 750,000 gallons daily per square mile are available in the water shed between the trap rock formation and the serpentine ridge, from which water shed the bulk of the Staten Island water at present is obtained. According to the figures of the City Commission, the area from which the pumping stations in this territory draw, comprises a total of 8½ square miles. Using this above figure for capacity per square mile, which is assumed to be reasonably correct, it is found that a total in this valley of nearly 6,500,000 gallons is available. It is difficult to say whether these figures indicate the actual extent of the water sources in this whole territory. It may be that there are other sites in this valley upon which pumping stations could be located and operated with favorable results, but these have not yet been determined. Concerning the plain region on the east side of the ridge of hills, this has not been sufficiently explored to form even an approximate estimate of the actual capacity of the water sources. The Grant City Pumping Station at present drains an area of about 1¾ square miles, which would give, according to the above figures, about 1 1-3 million gallons daily. The present pumping station does not draw over 1,000,000 gallons, therefore, there should be some water to spare at this one point, and it is possible that other favorable sites for pumping stations could be found. In short, the situation appears to be as follows: There are indications that some of the sources now in use upon the Island, if not at their limit, are very close to it, and there is very little satisfactory evidence showing that there is a plentiful supply of water to be obtained elsewhere on Staten Island. It might be possible to obtain such evidence, but not without extensive and costly experiments. Therefore, for present purposes nothing more than assumption can be made regarding the actual capacity of the water sheds.

Exterior Sources of Supply and Future Provisions

During a recent period a contract was made for a supply of water from the Hudson County Water Company of New Jersey. This contract is now being held up in the Courts pending a decision upon its validity, and the popular feeling in Jersey seems to be against selling any portion of their water to another State. However, if the decision of the Court is favorable, this New Jersey company will undertake to supply the western portion of Staten Island, at least. It is figured that a minimum of 3,000,000 gallons will be taken, and if this occurs it will render the present pumping station at West Brighton of little use. At any rate, all questions regarding the desirability of the present water would be settled in this event. This is the only outside source which is in any way available at the present time. It is expected that when the water supply for the Greater City of New York is availa-

ble from the Catskill regions there will be ample provision to extend the use of this same water to Staten Island. This point, however, will not be reached for some little time, probably ten years, and Staten Island will be obliged to take care of itself in the meantime with or without the help of the Hudson County Water Company. If the mentioned conditions are eventually realized, there should not be much danger of an ultimate scarcity of water for Richmond, and it is presumable that the present plants can take care of things during the intervening period.

VALUATION OF THE PLANTS

The Commission appointed by the Mayor of New York to investigate these private water companies has made an exhaustive inquiry into the sources of water supply, the equipment of the plants and systems, and all conditions governing the value of the water for water purposes. In establishing a valuation on the plants and properties of these companies, an assumption was made that water from the Catskill regions would be ready for use in ten years. It was also assumed that no other exterior sources of supply would be available within the period. Therefore, it was considered that in case the city desired to purchase these plants, of the actual properties owned by the companies the distribution systems and real estate would be the only items of permanent value. The value of the pumping stations, machinery, wells and appurtenances were considered, but it was decided that while they had a salvage value equal to what they could be sold for as second-hand material, they would be worth little or nothing to the city at the end of this ten-year period, and that the actual value of the water used during these ten years, minus the cost of pumping and operating expenses, was the principal point to establish. The separate items which were concerned in the final valuation are noted with figures as follows:—

Staten Island Water Company—	
Distribution system, as per schedule	$413,273.00
Source of supply valued for water	396,000.00
Going concern value $10 per service	53,000.00
Total approximate value	$862,273.00
Crystal Water Company—	
Distribution system, as per schedule	$392,819.00
Source of supply valued for water	289,570.00
Going concern value $10 per service	27,000.00
Total approximate value	$709,389.00
South Shore Water Company, Exclusive of land at Richmond—	
Distribution system, complete	$12,672.00
Source of supply (not included)	
Going concern value $10 per service	1,110.00
Total approximate value	$13,782.00
Summary—	
Staten Island Water Supply Company	$862,273.00
Crystal Water Company	709,389.00
South Shore Water Company	13,782.00
Total	$1,585,444.00

N.B.—The Staten Island plant would have a higher valuation were it not for the inferior quality of the water from the West Brighton station.

First. Replacing Distribution System.—This was figured on the basis of present prices of the pipe and material with deductions made for depreciation. A nominal deduction based on the age of the pipe was made for all sizes which would be suitable for use and a further deduction was made for all such pipe which was too small to be suitable for proper use in the distribution system. Ten per cent. deduction was made for all pipe of diameter above six inches, this being for supposed age deteriora-

Value of Water in the Ground

The value of the water in the ground is represented by the value of the water in pipes, less the cost of pumping it, and is estimated as follows:

Staten Island Water Company, Crystal Water Company

	Staten Island Water Company			Crystal Water Company			
	West New Brighton	Bull's Head	New Springville	Clove	Bull's Head	Grant City	South Shore
Average quantity per annum, million gallons	870	428	292	354	365	365	36
Average daily quantity, million gallons	2.38	1.17	0.80	0.97	1.00	1.00	0.10
Net value of water in pipes	$27.00	$66.00	$54.00	$63.00	$63.00	$64.00	$47.00
Cost of pumping, million gallons	20.70	23.20	34.80	20.70	40.00	27.90	38.40
Net value of water in ground	$6.30	$42.80	$29.20	$42.30	$23.00	$36.10	$8.60
Value per annum	$5,500.00	$18,300.00	$8,500.00	$15,050.00	$8,390.00	$13,160.00	$310.00

Total Value of Water for a Period of Ten Years

The present value of the annual income for ten years, discounted at 5 per cent., is 7.72 times the annual income. Multiplying the annual value of this factor, we obtain the present value of the water. From this deduction must be made in certain cases for new pumping machinery and additional wells. The pumping machinery of the Staten Island Water Company seems sufficient to maintain the service for ten years in each case. In the stations of the Crystal Water Company, in each case, new machinery will be required either to replace that which is worn out, or as a reserve to maintain the supply in case of accident to a single unit. The estimated cost of such additional machinery must be deducted, therefore, from the value of the water.

The quantities are as follows:

Staten Island Water Company, Crystal Water Company

	Staten Island Water Company			Crystal Water Company			
	West New Brighton	Bull's Head	New Springville	Clove	Bull's Head	Grant City	South Shore
Value of water in ground per annum	$5,500.00	$18,300.00	$8,500.00	$15,050.00	$8,390.00	$13,160.00	$310.00
Present value of this sum annually for 10 years, at 5 per cent	$42,400.00	$141,000.00	$65,600.00	$116,000.00	$65,000.00	$101,500.00	$2,400.00
Estimated cost of machinery required to maintain the supply for this interval	.....	.....	.....	15,000.00	15,000.00	27,000.00	.....
Net Value of sources for 10 years	$42,400.00	$141,000.00	$65,600.00	$101,000.00	$50,000.00	$74,500.00	$2,400.00

tion. Fifteen per cent. was deducted for all six-inch pipe and 50 per cent. for all four-inch and under. Gates were all rated at net value, while 10 per cent. was deducted from hydrants. In the case of the Crystal Water Company, which employed an extensive meter system, 20 per cent. was deducted from the cost of the meters, and the same also for service connections. Besides the piping, fair estimates were allowed for reservoirs, the value of sites of same also being included. Extra allowances were made for rock excavation and pavements encountered. An amount for engineering and contingencies was added at the rate of 15 per cent. of the estimated cost.

Second. Sources of Supply.—Assuming that water from exterior sources would be available as mentioned, in ten years, the value of the water which the private companies would supply in the meantime was figured, deducting cost of pumping and operating expenses. A standard value of $70 per million gallons for water in pipes was set (this being the same as the price agreed upon in the contract with the Hudson County Water Company, of New Jersey), and deductions made from this price, in connection with the respective sources, varying according to the results of analyses. The water from the West Brighton Station suffered the most in this respect, $13 being deducted for hardness (excess over 30), $10 for salt and iron, and $20 for population on water shed, leaving an actual value of $27. In the case of the other stations, a nominal deduction for hardness only was made, varying from $4 to $7, with the exception of the South Shore Company, where $13 was deducted. Thus a fixed price per million gallons was established for the water in the pipes. The actual cost of pumping and operating expenses at the different plants was figured as close as conditions would permit, and by deducting this cost from the above value of water in the pipes, a figure was arrived at which was considered to be the value of the water in the ground. By estimating the yearly pumping, the latter figure was reduced to a value per annum, and discounting this sum for a period of ten years at 5 per cent., the total value of this water for a period of ten years was ascertained. The tables on the opposite page illustrate the procedure in fixing the values.

It having been decided that no allowance could be justly made for the machinery and equipment at the pumping stations, the only remaining step to be taken in valuing the sources of supply consisted in appraising the real estate used by the well systems and pumping stations. After due consideration it was determined to value this at 200 per cent. of the assessed valuation of the land for the year 1905.

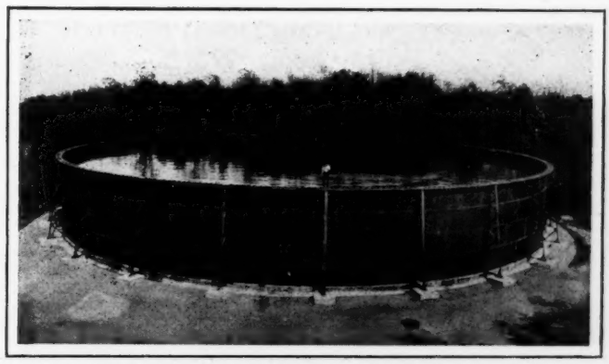
Third. A Going Concern Value at Ten Dollars per Service.—This was based on the franchises not being exclusive and therefore not of particular value, but assuming this, it was supposed that conditions encountered upon the installation of a new plant to do the same work would be different from those of the plant now in operation, in that it would take a certain length of time for a new plant to become established and to obtain the same number of consumers as the plants in consideration have at the present time. It was figured that $10 per service would cover this value.

The information set forth in this article has been obtained from three different sources: first, from a personal investigation of the companies and their properties, conducted in behalf of the City of New York through the Commission appointed; second, from reports submitted by the companies themselves, and third from the report of the Commission.

AN IRON STORAGE TANK

THE structure here described is believed to be the first instance of an iron tank whose dimensions justify its being classed as a city reservoir. This storage tank was furnished by Tippett & Wood, of Phillipsburg, N. J., to the Rochester & Lake Ontario Water Company, Rochester, N. Y. The water system of which it is a part was designed and built by the American Pipe Manufacturing Company, Philadelphia, Pa. The quality of the soil was very sandy and of a loose nature. An iron storage tank was then decided upon. This tank measures 150 feet in diameter, 20 feet high, and has a capacity of 2,640,000 gallons. It was erected on the top of a hill adjoining the city of Rochester. The tank rests on a foundation of concrete, about 1 foot in depth under the central portion of the tank, and 3 to 4 feet in depth around the outer edge. The tank is built of wrought iron plates throughout. Bottom plates are 3/8 inch thick; shell plates, 5 feet of 3/4 inch, 5 feet of 5/8 inch, 5 feet of 7-16 inch, and the top 5 feet of 3/8 inch. All horizontal seams and all seams of the bottom are single lap riveted. The vertical seams of the 3/4 inch and 5/8 inch rings are triple riveted with double butt straps; those of the 7-16 inch and 3-16-inch rings are double lap riveted.

As the tank is located in an exposed position, it was thought advisable to provide some bracing to withstand the action of high winds when it might be either partly or entirely empty. To provide against this wind pressure, therefore, a circular horizontal lattice girder 18 inches wide, was placed around the top of the tank on the outside. Reaching from this girder and extending down the side of the tank to the foundation, are twenty-four vertical beams or girders, the outer toe of these girders being anchored by bolts to the masonry, these vertical girders also being riveted rigidly to the shell of the tank and to the horizontal circular girder at the top of the tank.



AN IRON STORAGE TANK—DIAMETER, 150 FEET

MUNICIPAL WATERWORKS IN THE UNITED STATES

Interesting Data Collected by the Federal Census Bureau—Miles of Mains—Hydrants and Equipment—Receipts and Expenditures—Private Plants

THE table herewith presented is prepared from the latest data collected by the United States Census Bureau. It deals with municipal plants only, because it unfortunately seems impossible to obtain anything like complete data from private plants. Some experience with these leads us to believe that many of them, especially the smaller ones, do not have the data on their books, and really know very little about the details of the finances of their plants except total annual cost and expenditure; and have never determined the length of their pipe lines, number of hydrants, or other data of the system. Probably the reason for this is that the superintendent is generally a mechanic rather than a business man, or else is neither, and has never been shown the importance of this information in securing efficiency of operation and maintenance. Waterworks associations, however, are bringing about an improvement in this respect; and every superintendent should be a member of an association and get up to date.

The data given are thought to include every municipal plant but one in the country in cities of more than 25,000 inhabitants. Little comment on them seems necessary. The various items in the per capita columns run quite uniform. They show about 700 persons and nine fire-hydrants per mile of main in all, but the six largest cities, with an average total cost per capita of $28.55. The receipts are seen to exceed the total expenditures by 4.9 per cent. of the total cost, which must cover interest, depreciation, sinking fund, etc. It is probable, however, that much of the indebtedness for the plants has been paid off, and that most of the annual cost of repairs and renewals is included in the total expenditures.

DATA OF NEW ENGLAND PLANTS

More details would be very interesting but are not available for the entire country. We are able to present, however, many such for thirty-eight New England plants, which are as follows:

Populations of cities reporting, maximum, 927,800; minimum, 2,850; total, 2,366,158; average, 62,267. Average consumption, 68 gallons per day per inhabitant, 71 per consumer, and 513 per tap. The cost of supplying the water, per million gallons, based on total maintenance only, ranged from $13.86 to $125.52, averaging $50; if interest on bonds is included, $31.15 to $270.05, averaging $105.27. The cost of repairs to the pipe lines for the year averaged $8.50 per mile. The number of gate valves averaged 12.2 per mile. The pressure on the mains ranged from 10 to 150 pounds (23 to 345 feet). Two cities meter all services, twelve more than 75 per cent., fifteen more than 50 per cent., but six less than 10 per cent., and but one has less than 100 metered services. All of these plants pump at least a part (most of them all) of their water; the average head being 186 feet and the average duty 42,352,000 foot-pounds per 100 pounds of coal, ranging from 10,520,000 to 134,950,000. The pumping station expenses per million gallons raised foot high averaged 11.8 cents; but, excluding six extreme cases, the average was 7.6 cents, ranging from 2.5 to 17.5 cents.

These plants are probably as well managed as any in the country. The consumption per capita is kept low by use of meters and prevention of leaks and other losses; and the quality of water and of service is generally excellent.

It might be well for the officials of the Water Departments, and city officials generally, to give a little more attention to this subject, which every day is growing to be of greater importance. The reason that the New England plants have been so successful is that they have been well managed, and the fact that they are well managed is that the officials of the various cities and towns have communed with one another and have exchanged ideas. The New England Waterworks Association is recognized throughout the country as embracing in its membership some of the best informed men in the business. A decided improvement has also been noted in the recent past in the manner of conducting business at the private plants, and it is not too much to predict that the time is not far distant when matters will be conducted in a thoroughly up-to-date business way. The superannuated superintendents who have failed to keep abreast of the times are being succeeded by younger men who have studied the subject from a business and scientific standpoint and a betterment in conditions will not be long in developing.

Municipal Waterworks in the United States

Cities Having a Population of	No. of Cities Having Municipal W.W.	Percentage of All Cities in the Country	Miles of Mains		Number of Fire Hydrants		Cost		Value of Equipment Lands, Buildings, Etc.	Expenditures		Receipts	
			Total	Per Capita	Total	Per Mile of Main	Total	Per Capita		Salaries and Wages	All Other Expenses	Total	Per Capita
More than 1,000,000	3	100	5,135.8	0.00074	58,572	11.4	$216,758,395	$31.15	$119,937,052	$3,515,973	$3,019,091	$16,624,782	$2.39
500,000 to 1,000,000	3	100	2,103.0	0.00121	19,054	9.1	51,737,679	29.76	Not given	1,344,310	599,112	4,982,379	2.86
300,000 to 500,000	6	75	2,941.2	0.00140	25,107	8.5	57,357,910	27.35	47,444,740	1,162,297	822,843	4,520,531	2.16
100,000 to 300,000	20	80	4,500.3	0.00134	39,569	8.8	73,277,238	21.80	82,444 282	1,403,818	1,861,534	7,039,328	2.09
50,000 to 100,000	31	72	3,430.5	0.00149	26,320	7.7	71,868,767	31.17	68,826,556	1,009,967	1,044,686	5,909,012	2.56
25,000 to 50,000	63	67.7	3,187.6	0.00145	31,620	9.9	61,613,508	28.06	72,433,992	925,699	1,062,064	4,905,486	2.24
Totals and averages	126	72	21,299.3	0.00114	200,242	9.4	$532,613,497	28.55	.....	$9,362,064	$8,409,330	$43,990,518	$2.36

PRACTICAL WATER SOFTENING FOR MUNICIPALITIES

Art Has Attained Perfect State After Sixty Years of Scientific Study—Various Stages and Processes of Treatment—Imperfections of Machines Overcome

By C. HERSCHEL KOYL

(Second Paper)

It should be understood that there are no mysteries in the art of water softening. The present practically perfect state of the art has been attained by sixty years of continued study by scientific men, and to understand it there is necessary only a reasonable knowledge of chemistry and mechanics, and a little common sense.

The whole process consists of two parts: first, getting the dissolved calcium, magnesium, etc., out of solution and into suspension in the water; and second, getting this precipitate out of suspension and settled in the bottom of the tank.

For any ordinary hard water the reagents to be used are fresh lime for the extraction of the free and loosely-combined carbonic acid gas, and the consequent precipitation of the mono-carbonate of calcium; and sodium carbonate, to change the sulphate and chloride of calcium and magnesium into sulphate and chloride of sodium. For clearing soft water from matters in suspension, such as mud and oil, it is necessary to add some two reagents, for instance caustic soda and sulphate of iron, which will combine to produce a flocculent precipitate, in this case hydrate of iron, which will carry down with it all the suspended matter.

Historical

From 1840 to 1880 the business of water softening was operated on a comparatively small scale, because people had not learned that it is cheaper to pay for softening hard water than to use it. The apparatus was simple and consisted in each case of two tanks used alternately, softened water being drawn from one while the water in the other was being treated and settled. When one of these tanks had been filled with hard water, enough fresh lime was added to it to cause the precipitation of all the dissolved carbonate of lime, and the mass was then stirred by hand until the last drop of hard water had received its little proportion of lime. Then the whole was allowed to settle a day or so, until the water was clear. Within a few years there was added the treatment with sodium carbonate, and the combined operations were carried out with intelligence and thoroughness; but the operation was of necessity slow and the apparatus of small daily output. After some forty years of this demonstration work, the time came (about 1880) when men began to realize the commercial value of soft water and set themselves to devise such mechanical contrivances as should increase the working capacity of these plants. The principal difficulty was the loss of time in filling and emptying the tanks. Their size could not be increased indefinitely, because such large tanks could not be properly stirred, and they would occupy too much space for the factories, which were then the only customers.

The Continuous Process

It was necessary so to arrange the apparatus that a steady stream of hard water might flow into one side of the machine and an equal stream of softened and clarified water flow from the other side, ready for use. This in turn necessitated controlling the rate of inflow of hard water by the rate of outflow of softened water, by a valve placed in the inflow pipe, which allowed the hard water to come in only as fast as the softened water was taken out. The third necessity was to make the supply of lime continuous and at all times strictly proportional to the amount of hard water flowing in; the fourth, to make the supply of sodium carbonate continuous and proportional to the inflow of hard water; the fifth, to make possible the renewal of these reagent supplies and the discharge of the accumulated precipitate, without disturbing the continuity of the water treatment.

The Lime Treatment

If the hard water contains only carbonate of calcium and we use only fresh lime for its dislodgment, we see at once that the chemical action between the lime and the CO_2 is rapid, and that the released carbonate of calcium is precipitated in large flakes, like snowflakes, which settle through the water rapidly and soon leave it clear enough for use.

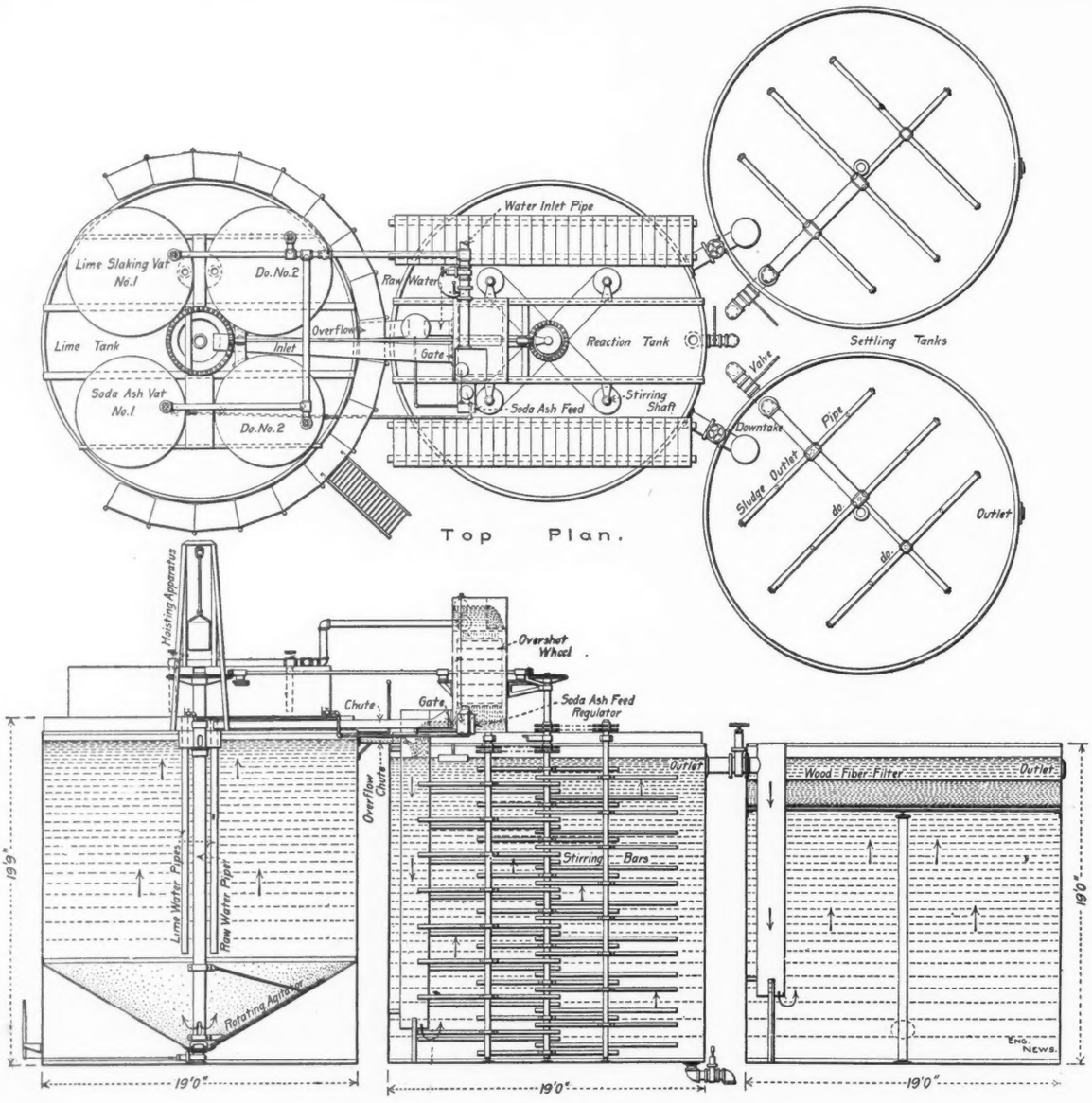
With water of a given hardness, and lime of known purity, it is a simple matter to calculate and supply the exact amount of lime necessary; but commercial limes are of varying degrees of purity, containing from 2 to 60 per cent. of magnesia; and the burning to which the limestone is subjected varies in thoroughness; so that in a ton of purchased lime there may be two thousand pounds of pure lime, or there may be as much as twelve hundred pounds of magnesia and perhaps two hundred pounds of unburned limestone, leaving only six hundred pounds of pure lime available for water softening purposes. It is therefore utterly useless to say "put in one hundred pounds of lime," unless we know the character of the lime. A first improvement was made by slaking the lime before use, thereby getting rid of the unburned stones in the lime, but not of the magnesia, which goes with the slaked lime and is indistinguishable from it. A mixture of slaked lime with enough water to make it flow is called milk of lime, whether the lime is pure or whether it is half magnesia, which is useless; but to this day there are foolish men calling themselves "water softeners," and accepted as such by some confiding customers, who advocate the use of milk of lime by measure for water softening. But the men who devised the first "continuous" apparatus were wise enough to

utilize the only method by which an absolutely definite amount of CaO can be supplied by weight or measure—that is, by its solution in water. A pound of water at a given temperature will always dissolve the same number of grains of CaO; and it will not dissolve magnesia nor unburned limestone. If, then, we flow a definite stream of water upward through a mass of milk of lime, we shall get at the top of our containing vessel a clear stream of saturated lime water which has left behind the magnesia and stones, but which contains just so many grains of

ous" process, by the aid of a small tank for the manufacture of lime water attached to the large tank used for the general precipitation. In practice this method works perfectly, and we can always safely wager on the exactness of the precipitation to within one grain of carbonate of lime per gallon of water, or one part in 70,000.

THE SODA TREATMENT

If the hard water contains only sulphate of calcium, and we use only sodium carbonate for its expulsion, we find that the chemical action is not so rapid, and that the



MODERN WATER SOFTENING MACHINE—VERTICAL SECTION

CaO per pound or per cubic foot of water. Since the amount of lime necessary to soften water may always be dissolved in a portion of that same water, the plan which is most simple and also most exact is to divide the stream and allow a certain percentage of our incoming hard water to flow through milk of lime, and to join the main stream again after it has become saturated lime water. This plan was put in use by the fathers of the "continu-

precipitate formed is fine and so slow to settle that the water is not clear enough to use for many hours, and sometimes for two or three days.

If our hard water contains both carbonate and sulphate of calcium, and we therefore use both fresh lime and sodium carbonate as reagents, we find that they do not interfere with each other, but that both chemical reactions are carried on simultaneously and with complete success;

and we find that the large particles of precipitate produced by the lime water are very effective in carrying down with them the fine particles of precipitate produced by the sodium carbonate. In the "continuous" apparatus, it was therefore necessary also to place on top of the general precipitation tank a small tank to contain sodium carbonate solution, and fit it with a valve controlled by the general system, so that both lime water and sodium carbonate solution could and must flow in proportion to the rate of the hard water.

The Mechanical Treatment

The above-mentioned reagents are sufficient for the treatment of any ordinary hard water; but it must be remembered that if the treatment is to be complete, every drop of water must get its little proportion of chemical, and it can get it only by thorough stirring. This was a point in which the men who devised the first "continuous" machines were at fault, through their failure to realize that liquids of different natures do not mix readily. If one wishes to see the difficulty of mixing two kinds of water, let him pass in a boat over the junction of two rivers, for instance the St. Lawrence and the Ottawa, where for a long distance these two streams flow side by side with a definite dviding surface and no apparent mingling. All the European "continuous" machines rely for their mixing upon running the combined streams of hard water, lime water and sodium carbonate around a few baffle plates; and although the mixture thus effected is sufficient to make a great improvement in the water, still the mixing is not thorough. I have seen many such machines turning out water in which the chemical reaction was not complete after two hours' standing; and I have even seen water from such machines still forming precipitate after the water had been turned into the storage tank. In neither case were the chemical reactions completed, as they should have been, within the precipitation tank of the machine, and this was the result simply and solely of a want of proper mixing. It remained for a citizen of the United States to insert in the general precipitating tank a stirring apparatus, requiring no outside power, because it was actuated by a water-wheel, which in turn was operated by the stream of inflowing hard water; and since this improvement has been in use it has been demonstrated that the necessary chemical reactions can be completed, at any time of year, within thirty minutes, on the sole condition that the chemicals are thoroughly mixed with the water. It is not the chemical reaction which is slow and difficult; it is the mechanical work of getting the chemicals distributed through the water.

These are the essentials of the art of getting the salts of calcium and magnesium out of solution in the water and into the form of precipitate, suspended in the water but ready to settle if we give it sufficient time.

The Agglomerating Treatment

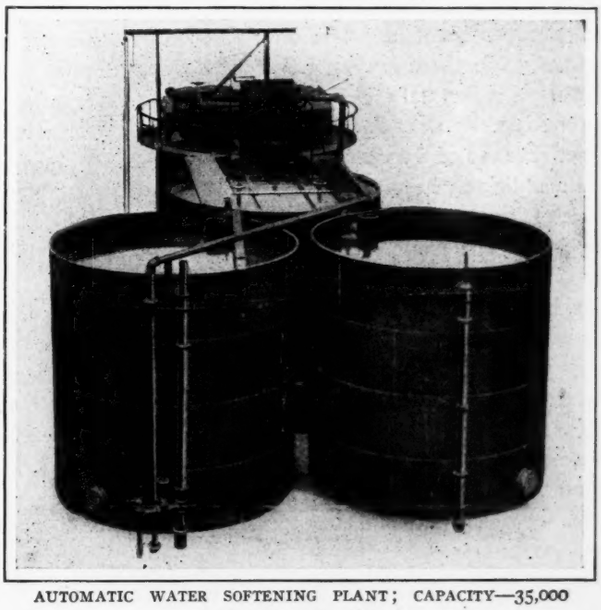
It remains to get the precipitate out of the water as rapidly as possible, because our chemical operations have required only half an hour, and we desire to clarify the water quickly, so that we may keep small the dimensions of our tanks.

It was noticed a long time ago that if some old precipitate is thoroughly stirred and mixed with hard water while it is being treated, not only does the chemical reaction appear to be more rapid, but also the settling of the precipitate. This seems to be due to the tendency of the particles of young precipitate to gather around any particles already in the water, as a nucleus; and as these large particles sink through the water they gather the small particles to themselves, like a large snowball rolling down hill, and the result is exactly what we hope for. It remained also for a citizen of the United States to devise the apparatus by which this agglomerating action might be utilized in the "continuous" machine, in which there is no hand work and no possibility of bringing back precipitate which has once gone out.

The apparatus devised consists of a small tank placed between the precipitating tank and the settling tank, with the pipes so arranged that the water containing the young and fine precipitate passes out of the precipitation tank at the bottom, into the agglomerating tank at the bottom, and rises through it to overflow at the top into the settling tank. The result of this is gradually to fill the agglomerating tank with very large pieces of precipitate, which always tend to sink through the water, but also always tend to be carried up by the current of the water, so that the amount of precipitate held suspended in the water of the agglomerating tank soon becomes a constant, and for the millions of small particles per second coming in at the bottom there passes out per second at the top the same amount of precipitate by weight, but here gathered into a few hundred large pieces which soon reach the bottom of the settling tank. The clarified water then flows out of the top of the settling tank, and the apparatus need not be encumbered with filters.

State of the Art

The result of progress since this process was introduced into the water softening art in 1900 has been such that it is perfectly safe now to state that any kind of water to be found in the United States can be softened so that it shall contain not more than four grains per gallon, or one part



AUTOMATIC WATER SOFTENING PLANT; CAPACITY—35,000 GALLONS PER HOUR

in 17,000, of the salts of calcium and magnesium; that such water is soft, and clear as crystal; that it is almost ideal for drinking, for the laundry, for boilers, or for any industrial use; and that the whole process can be completed within two hours.

When the author began this work in 1899, it was with difficulty that anyone could be induced to buy a water-softening machine with a working capacity of 1,000 gallons of water per hour. It was necessary to convince the public by continued demonstration that the thing can be done, that the water is eminently satisfactory for any industrial use, that in a boiler it will neither scale, corrode, nor foam, and that the process is cheap. Within a year it became possible to sell, successively, water-softening machines of 2,000, 3,000, and 5,000 gallons per hour. In 1901 was erected the first "continuous" water-softening machine in this country of a working capacity of 10,000 gallons per hour. And, from that year, confidence has so increased among the owners of large industrial plants that now machines of 100,000 gallons per hour capacity are sold, and machines of 1,000,000 gallons per hour can just as easily be made and guaranteed.

An illustration of one of these modern water-softening machines is appended to show its general appearance and its operating devices. In this particular case the water treated requires an enormous amount of lime, and consequently the size of the lime tank is much greater than ordinarily required. The combined capacities of the precipitating tank and the settling tank should be that of a two hours' run; in other words, if the working capacity of a machine is to be 10,000 gallons per hour, the static capacity of these tanks combined should be 20,000 gallons.

A third paper will discuss some of the financial questions involved.

WOODBURY'S WATER PLANT

THE waterworks of Woodbury, N. J., were built by the city in 1887 with the proceeds of a 4 per cent. bond issue at an initial cost of $72,000. Approximately $28,000 has since been expended in improvements. Last year $10,000 was spent in extensions; $20,000 of bonds were paid off, and there is now a $10,000 sinking fund in the treasury. The total revenue for last year was $11,758.13; maintenance, $4,412.89; betterments, $1,982.73, leaving a net revenue of $5,362.51.

In addition, the city had fire service from 104 plugs, which, figured at regular rates, would be $2,600; also no charge was made for flushing sewers and other public service. The Treasurer in his report estimates that the city has saved in fire service alone since the installation $37,250.

Superintendent Samuel E. Wilmer has been connected with the department since 1890 and states that the policy of the department is to furnish an unlimited water supply at as low a rate as possible. As the consumption per capita is about 400 gallons daily, it is evident the quantity is sufficient; but it is a question if economy in preparing could not lower the rate. There was pumped in 1905, 186,957,500 gallons with a coal consumption of 523,750 pounds and a cost of about $1,000.

A WATERWORKS CONVENTION

Papers Prepared for the Annual Meeting of the American Association—Great Variety of Subjects—Boston to Entertain Delegates

List of papers to be presented at the twenty-sixth Annual Convention, Boston, Mass., July 10-14, 1906. These papers will be read by title in the order listed.

1. The Growth of the Pumping Station. Chas. A. Hague.
2. Expanding Water Supply Systems. J. T. Fanning.
3. Extension and Improvements in the Supply Main, Yarmouth, N. S. George H. Robertson.
4. A Pictorial Appeal; Water-Works Too. H. F. Dunham.
5. Cheesman Dam. Geo. T. Prince.
6. Notes on Comparative Efficiency of Cast-Iron and Riveted Pipe. L. J. LeConte.
7. Notes on Sewage Purification and Public Water Supplies. M. N. Baker.
8. Report of Committee on Water-Works Standards.
9. Standard Cast-Iron Water Pipe with Specifications for Same.
10. Standard Specifications for Cast-Iron Pipe and Special Castings.
11. Copper Sulphate Results. J. M. Caird.
12. A Retrospect of an Arbitration on the Value of a Water-Works. Albert H. Wehr.
13. River Pollution. Marshall O. Leighton.
14. Synopsis of Paper on Disinfection as a Means of Water Purification. George C. Whipple.
15. A New Hydraulic Unit. Daniel W. Mead.
16. Simplex Water Meter. J. W. Ledoux.
17. Boiler Plant Economy. C. H. Hurd.
18. High-Pressure Water Systems. F. L. Hand.
19. Water Softening for Municipal Supplies. George W. Fuller.
20. The Rôle of Public Water Supplies in the Spread of Typhoid Fever as Shown Chiefly by the Greatest Typhoid Epidemics. George A. Soper.
21. The Chicago Drainage Canal Case. Dr. William P. Mason.
22. The Chicago Drainage Canal in the United States Supreme Court. John W. Hill.
23. The Natural Purification of Streams. Edwin O. Jordan.
24. Testimony by T. J. Burrill of the University of Illinois. Professor Burrill.
25. Pump Slippage. Alba L. Holmes.
26. Increasing the Capacity of the Hackensack Water Company's System. D. W. French.
27. Protection of Meter Register. C. E. Loetzer.
28. Some Interesting Facts Regarding the Great Earthquake of April 19, 1906. L. J. LeConte.

Synopses

Growth of the Pumping Station.—Charles A. Hague, Consulting Engineer, 52 Broadway, New York City, will treat of the demand for increased capacity in the past, and advise that such wants be provided for in the future. Considerations of economy must govern plans for providing for the greater demand, and the various pumping devices have to be considered in connection with this subject. While turbine engines and gas producers may figure largely, the author thinks that developments of pumping stations along the present lines are more probable, as pumping engines now built, notably those of the vertical triple-expansion type, are very economical.

Expanding Water-Supply Systems.—J. T. Fanning, Consulting and Civil Engineer, 330 Hennepin Avenue, Minneapolis, Minn., will explain the necessity of impressing on Councils and citizens generally the elementary principles of the flow of water in pipes. Failure to understand these principles on the part of the appropriating powers is responsible for the insufficiency of pressure in sections of many cities. The author will discuss friction-head losses in pipes, and recommend the general policy of construction of additional mains to sections of systems where pressure is low.

Extension and Improvement in the Supply Main, Yarmouth, N. S.—George H. Robertson, Superintendent of Waterworks, Yarmouth, Nova Scotia, will describe how he cleaned of tubercles, with which it had become clogged, part of a twelve-inch main, fifteen years old, with a simple scraper of his own invention. He will relate how a thousand feet of new main were put in, replacing an equal amount of pipe twenty-two years old, and how connections were made in three hours from the time the water was shut off. The pipe thus replaced was cleaned by a scraper of different design and was again laid in place. After these changes the pumps ran smoothly, although before a three hours' run would create a vacuum.

A Pictorial Appeal; Waterworks, Too.—H. F. Dunham, Consulting Engineer, 220 Broadway, New York City, will describe and illustrate with lantern slides some interesting problems of water levels in the Great Lakes. The conclusions reached by a writer in the Smithsonian Report of 1898, regarding tilting of the Continent in the lake region, will be questioned. Some interesting records made by the speaker, suggesting other possibilities regarding causes in variation of lake levels, will also be presented. An appeal will be made to officials in charge of waterworks stations along the shore to keep accurate records, with a view to arriving at more definite determinations regarding changes of level.

Cheesman Dam.—George T. Prince, Engineer, will describe the dam built by the Denver Union Water Company, Denver, Col., to store the waters of the South Fork of the South Platte river. The object for which the work was undertaken—to provide for the contingency of a succession of dry years and not as an ordinary supply—will furnish an interesting study of what may be accomplished for a city by the wisdom and foresight of a private corporation. The photographs which Mr. Prince will show will illustrate the picturesque scenery of the site as well as the topographical conditions.

Notes on the Efficiency of Cast-Iron and Riveted Pipes.—L. J. LeConte, Civil and Consulting Engineer, Oakland, Cal., will give an account of his observations on cast-iron and wrought-iron riveted water pipes. As steel is now displacing wrought-iron for use in riveted pipes, the author will draw such deductions as he can regarding the probable durability of steel pipes.

Notes on Sewage Purification and Public Water Supplies.—M. N. Baker, Civil Engineer, 220 Broadway, New York City, will speak on the relation between sewage purification and water filtration. The speaker will urge the necessity of keeping more careful records of vital statistics as a means of verifying the purity of the water supply. He will define the terms ordinarily used in describing sewage purification processes, and will add a bibliography of the subject.

Report of Committee on Water Works Standards.—This committee, which has devoted most of its time during the past year in an endeavor to standardize cast-iron water-pipe specifications, will make a preliminary report, subject to provisions and corrections by the convention. The items were drawn up after conferences with the committee of the New England Waterworks Association, the American Society for Testing Materials, the Western Society of Engineers, and the American Manufacturers' Committee.

Standard Cast-Iron Water Pipe, with Specifications for Same.—Charles A. Hague will present tables of dimensions and weight of pipes of seven different thicknesses, corresponding to different limiting pressures. He will advocate that, for the same nominal inside diameter, the outside diameter of the body of the pipe, the outside diameter of the spigot and the inside diameter of the bell, all remain the same for all pressures and thicknesses of pipe.

Standard Specifications of Cast-Iron Pipe and Special Castings.—The standard specifications will describe the pipe, give allowable variations in dimensions and weight, and describe the quality of the iron, and tests of material. Castings will be described, methods of cleaning and inspection stated, coating, testing and weighing, and method of inspection defined.

Copper Sulphate Results.—James M. Caird, Chemist and Bacteriologist, 271 River street, Troy, N. Y., will give some results of extended experiments with copper sulphate applied to the waters of a number of reservoirs in New York State. The disappearance of algæ and infusoria under this treatment will be clearly shown, as well as effects on other properties of the water; beneficial effects in increasing bacterial purity, according to the speaker's observations are less definite.

A Retrospect of an Arbitration on the Value of a Waterworks.—Albert H. Wehr, Secretary and Treasurer, The Baltimore County Water and Electric Co., Baltimore, Md., will review the circumstance that led up to the condemnation of a portion of the water company's property by the city. He will mention the claims made by the water company for value of appliances taken and the indirect damages. The award of the arbitrators was a lump sum equal to the capitalization on a 4 per cent. interest basis of the net income lost, no compensation apparently having been allowed for the loss of franchise value above its present earning capacity.

River Pollution. A Discussion of Its Present Status and Suggestions Concerning Remedial Policy.—Marshall O. Leighton, U. S. Geological Survey, Washington, D. C., after calling attention to the fact that a reasonable amount of pollution is inevitable, will discuss methods of accomplishing purification and standards of purity that should be required in waters allowed to flow into streams. He will advocate concerted action on the part of the States, or national legislation, to establish definite standards of purity. The importance of immediate action on the matter, instead of allowing the pollution to go on until the remedial measures will not only be expensive but will seriously disturb industries, will be urged.

Synopsis of a Paper on Disinfection as a Means of Water Purification.—George C. Whipple, Consulting Engineer, 220 Broadway, New York City, will read an abstract of a paper which, besides dealing with the problem in a general way, will give a full account of the use of chlorine and ozone in European practice. Chlorine is in use at Ostenden and Middelkirke, Belgium.

A New Hydraulic Unit.—Daniel W. Mead, Consulting Engineer, First National Bank Building, Chicago, Ill., will suggest as a convenient unit in hydraulic computations the "circular inch," that is, the volume of a cylinder one inch in diameter and one foot long. The convenience of this unit to the hydraulic engineer will be explained and the solution of a number of problems illustrated.

Simplex Water Meter.—J. W. Ledoux, C.E., 112 North Broad street, Philadelphia, Pa., will describe a water meter of his invention which he has developed from an apparatus for measuring the flow of water over weirs, by means of a metal dial that need be read only at intervals. The author believes his meter will obviate the objection that water-works managers have had to the use of meters on water mains on account of the expense of maintenance, reading and adjustment.

Boiler Plant Economy.—C. H. Hurd, Urbana, Ill., will discuss the question of station economy with reference to boiler room practice, and give some suggestions as to best methods of handling fires. The question of quality of coal will be touched upon, and some hints given as to its choice so as to suit the plant in use and reduce the cost per unit of steam consumed. The use of stokers will be advocated as producing more uniformly favorable results than hand-firing, although short-time tests may not verify this conclusion.

High-Pressure Water Systems.—F. L. Hand, Late Chief, Bureau of Water, Philadelphia, Pa., will give a very thorough description of the high-pressure fire service recently installed in that city. The question of steam *versus* gas for such plants will be gone into, and the reasons of economy stated that led to the choice of gas engines as the motive power in the Philadelphia station. Interesting details of tests and method of operation will be given. The speaker will advocate the use of similar power plants for fire service in small towns.

Water Softening for Municipal Supplies.—George W. Fuller, Consulting Expert on Water Purification, 170 Broadway, New York City, will touch on the subject of the desirability of water softening from the standpoint of economy. The construction and operation of softening plants will be described, located in Southampton, England, Cincinnati, O., Freeport, Ill., Columbus, O., and the proposed plant at New Orleans La., will be outlined.

The Rôle of Public Water Supplies in the Spread of Typhoid Fever, as Shown Chiefly by the Greatest Typhoid Epidemics.—George A. Soper, Ph.D., Consulting Sanitary Engineer, 39 Broadway, New York City, will discuss some of the ways in which water supplies become contaminated and review the history of a number of epidemics, giving their causes so far as they have been traced.

The Chicago Drainage Canal Case.—Dr .William P. Mason, professor of chemistry, Rensselaer Polytechnic Institute, Troy, N. Y., will discuss the suit known technically as the State of Missouri *vs.* the State of Illinois and the Sanitary District of Chicago. The speaker will touch on the nature of the work, the benefits derived by Chicago from its completion, the general argument of each party to the suit, together with a brief abstract of the decision according to which the damage claimed was "not proven."

The Chicago Drainage Canal in the U. S. Supreme Court.—John W. Hill, Consulting Engineer, 35 Glenn Building, Cincinnati, O., will present a summary of the testimony offered by the defense in this suit, in which he was an important witness. The question of the quantity of sewage delivered into the Illinois River before and after the improvement will be considered; the general subject of the density of population in river basins in relation to river pollution will be dealt with at length.

The Natural Purification of Streams.—Edwin O. Jordan, Professor of Bacteriology, University of Chicago, will review the testimony in the Chicago Drainage case from the standpoint of the bacteriologist; the question at issue was, How far can typhoid bacilli travel in a running stream? The natural tendency toward purification of the stream will be clearly shown and how repeated pollution along its course has prevented it from being a good water supply when unfiltered. As a matter of fact, about 50 per cent. of all drinking waters in actual use are unsatisfactory.

Testimony by T. J. Burrill, of the University of Illinois.—Prof. Burrill will give an abstract of his testmony in the Chicago Drainage Canal case to prepare which he had made 2,800 samples of water analyzed and had 30,000 cultures of bacteria prepared. From these investigations it appeared that the increased volume of water from the lake made the waters of the Illinois river purer so far as organic constituents were concerned, but increased the bacterial contents at some points, as the fermentation process was pushed down to a lower point in the river.

Pump Slippage.—Alba L. Holmes, Hydraulic Engineer, 574 Wealthy avenue, Grand Rapids, Mich., will give the results of some tests on pump slippage in cities of moderate size and will show that the ordinary figures assumed for slippage require actual verification in order to avoid erroneous assumptions as to capacity of water supply, cost account, and water not accounted for by meters.

Increasing the Capacity of the Hackensack (N. J.) Water Company.—D. W. French, Superintendent, will describe the system by which introducing a relay pumping station reduced the expense as compared with the cost of a new force main. The company supplies forty-one towns and boroughs with a total amount of 20,000,000 gallons of water per day.

Protection of Meter Register.—C. E. Loetzer, Superintendent Sayre Water Co., will speak on the efficacy of any known device for furnishing complete protection against manipulation of water meters and will maintain that meter manufacturers must make a meter that cannot be tampered with.

Some Interesting Facts Regarding the Great Earthquake of April 18, 1906, which was Followed by a General Conflagration Involving Over One-half of the Entire City of San Francisco, Cal.—L. J. LeConte, Civil and Consulting Engineer, Oakland, Cal., will report to the convention details of the effect of the earthquake on the waterworks and distributing system.

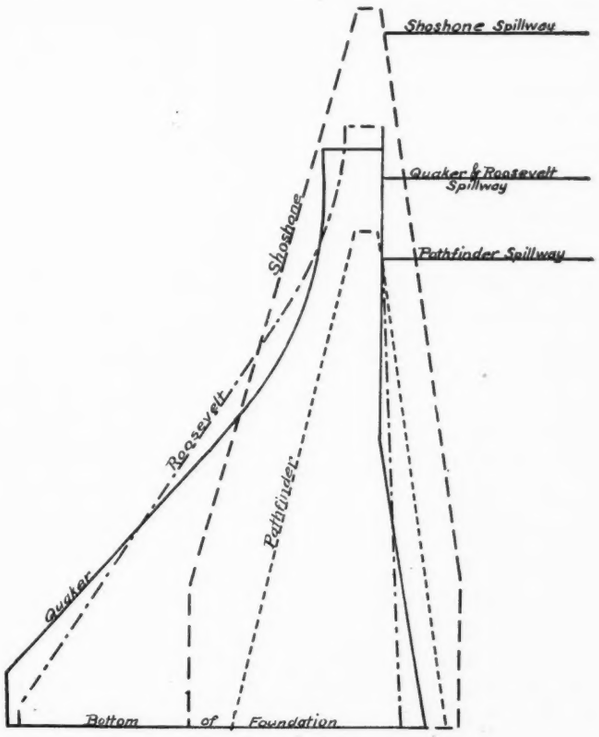
ECONOMY OF DAM CONSTRUCTION

Remarkable Engineering Feats of Federal Reclamation Service—Roosevelt, Pathfinder and Shoshone Reservoirs in West—Comparison with Great Eastern Dams

ONE of the most surprising features connected with the work of the Reclamation Service, as well as the one affording highest gratification, is the cost of structures compared with those which have become familiar to engineers in the East.

When the reclamation work was inaugurated it was a matter of conjecture whether or not the standards of cost for dams, canals, etc., that had been established by engineering practice in the eastern part of the country could be relied upon as a basis of estimates of the cost of the proposed Western structures. As the work has progressed it has become more and more evident that many classes of engineering work in the West can be performed considerably cheaper than in the East, and at the same time the natural conditions are such that these structures are more economical and effective.

If we take, for example, the three great masonry dams now being erected for the purpose of storing water, viz., the Roosevelt dam in Arizona, the Pathfinder dam in southeastern Wyoming, and the Shoshone dam in northwestern Wyoming, we shall find that the effective storage capacity and costs are far below those of some of the great Eastern dams, like the New Croton in New York and the Wachusett in Massachusetts. The heights of these dams are as follows: Roosevelt, 280 feet; Pathfinder, 210 feet; Shoshone, 308 feet: New Croton, 297 feet; and Wachusett, 207 feet. These heights are measured from the foundation stones to parapet in each case, and they show that the Shoshone is the highest, while the New Croton is second and the Roosevelt third. If, however, the height above the river bed be considered, that is, the effective storage height, the New Croton is the lowest. The order is then as follows: Shoshone, 240 feet; Roosevelt, 230 feet; Pathfinder, 200 feet; Wachusett, 185 feet; and the New Croton, 157 feet. In other words, about 50 per cent. of the masonry in the New Croton dam is below ground and is serviceable for foundation purposes only.



CROSS-SECTIONS OF AMERICA'S HIGHEST DAMS

COMPARATIVE STORAGE CAPACITIES

It is interesting to note the comparative reservoir capacities. While the New Croton dam is the largest in the world, from the standpoint of its amount of masonry, the storage capacity of the reservoir formed by it is by far the lowest of any of those above mentioned. In fact, from a standpoint of storage economy, the New Croton reservoir is one of the poorest that has been constructed in recent years. The dam contains 833,000 cubic yards of masonry and was erected at a cost of $7,600,000. The capacity of the reservoir formed by it is 4,000,000,000 cubic feet, or a cost of $1,900 per million cubic feet storage. Similar figures for the Wachusett dam show that it contains 280,000 cubic yards of masonry, and was erected at a cost of about $2,000,000. Its storage capacity is 8,400,000,000 cubic feet, or a cost of $238 per million cubic feet storage. In contrast to these excessive costs, the three Western dams appear remarkable. The Roosevelt dam, for example, contains 350,000 cubic yards of masonry erected at a cost of $3,850,000. The capacity of the reservoir is 61,000,000,000 cubic feet, or fifteen times that of the New Croton, and about seven and one-half times that of the Wachusett. The cost of this dam per million cubic feet storage is only $63.16. Even more remarkable appears the Pathfinder dam. It contains 53,000 cubic yards of masonry, erected at a cost of $1,000,000. The capacity of the reservoir is 43,560,000,000 cubic feet, or more than ten times that of the Croton. The cost of the dam per million cubic feet storage is therefore only $22.95 as against $1,900 for the New Croton, and $238 for the Wachusett. Similar figures for the Shoshone dam, the highest in the world, are: Cubic yards of masonry, 69,000; cost, $1,000,000; capacity of reservoir, 20,000,000 cubic feet, or a cost per million cubic feet storage of $50.35.

NATURAL FACILITIES HELP

These extremely low costs have seldom been equaled in the history of reservoir construction, and are due largely to the excellent natural facilities which are found in the rugged Western country. From this fact it must not be inferred that these Western structures are simple

engineering works. On the contrary, owing to their isolated location, their inaccessibility by rail, and often by wagon, and the erratic and torrential character of the streams, they involve problems which tax the skill and ingenuity of their builders to the utmost.

It is most fortunate that these reservoirs provide enormous storage at relatively low cost; otherwise their construction would not be feasible, as the irrigated land could not bear the expense of the costly structures of the East with their limited storage capacity.

The Croton dam, if it had been constructed in Salt River Valley in Arizona for irrigation, would only supply 23,000 acres, and irrigators would have to pay $330 an acre for stored water, as against $20, the estimated cost from the Roosevelt dam.

CONTAMINATED WATER SUPPLIES

Remedies for Evil in Small Cities—Indianapolis Expert Advances Ideas—Prevention of Disease—Purification Plants

Charles Brossman, Jr., consulting engineer, of Indianapolis, in a paper read recently before the Indiana Engineering Society, said it was not his intention to deal in detail with the subject of water purification, but rather to bring forward some points which seem to be of paramount importance, especially to smaller cities and towns having contaminated water supplies. The problem in itself is broad, and the investigation and determination of the proper procedure demands careful work by the sanitary engineer and often the co-operation of the biologist, the chemist and the engineer in order to arrive at a proper means of remedying the evil.

There are numerous sources of contamination, those doing the most harm varying in different localities. Sewage pollution and industrial waste are the important offenders. This latter class covers a variety of industries, comprising straw board and pulp mills, abattoirs, tanneries, textile industries, oil refineries and oil wells, rod and plate mills, starch and soap works and numerous small industries which contribute their waste to the grand total in making public sewers of our water supplies. . . .

While some cities are so situated that they can turn to a subterranean supply for pure water, or are able to draw from some sparkling mountain stream or lake in which there is no chance of pollution, the greater number of our American cities are so located that the river from which they have their supply is the only available source. These cities must turn to some other way than the procuring of a new supply. But one path is open to such a community; so long as its neighbors will not cease pollution it must turn to purification.

Let us consider mainly the prevention of disease from these contaminated supplies, or the relation of pollution to public health, taking as an index typhoid fever, which, when it appears in epidemic form, does more harm to a municipality than all the other forms of pollution. This disease, when water-borne, may be stated as coming from municipal or individual contamination, never from the lower animals. There are two remedies to such contamination, namely, sewage disposal and water purification.

Making a comparison of death rates before and after the use of purified water we find the average of nine prominent cites to be six per 10,000 before filtration, and .83 per 10,000 after. . . . Turn your attention to some actual cases of severe epidemic of typhoid fever from contaminated waters. Count the loss in money that has actually occurred, placing no value on lives lost. At Plymouth, Pa., a town of about 8,000, they had 1,104 cases which actually cost $115,000, or over $100 for each case of sickness; or take Butler in the same State, a town of 16,000, in which they had 1,800 cases of typhoid which cost $75,000, or over $60 for each case of sickness. Take any town where there has been an epidemic or a high death rate, and it will be found in most cases that the loss for attendance to the sick would alone, in a few years, have paid for an entire purification plant. Here it is shown that the ounce of prevention is no fallacy.

I realize that the installation of water purification systems and sewage disposal plants to prevent pollution is an unpopular municipal project owing mainly to the fact that such plants are not direct money producers. The sewage disposal plant, especially, becomes a greater burden as the population increases, but with the increase of population it will not be long before the State must prevent such contamination by the passage of laws compelling the construction of sewage disposal plants; and cities will have to build their purification systems as a matter of self interest and protection.

That most waters can be made potable and safe is a fact that cannot be disputed if the proper methods be employed; and it is equally certain that some cities and towns have systems which are not giving satisfaction. Some plants have failed due to improper management, some to poor design, some to unsuitable installation. I wish to dwell more upon the last class and what could be done to prevent such errors.

The necessity of a purification plant being apparent to a city or town, steps are generally taken to install some system to accomplish the desired result. In the case of a large city the matter of recommendation is generally put in the hands of an expert or a board of experts—trained sanitary engineers competent to design a system suitable to the needs of a community.

The smaller cities and towns are, however, often not fortunate enough to get the proper method of purification even when they have the means for such an investment. For instance, here is a town whose water supply is polluted. A commission is appointed by the Mayor to investigate and decide as to what should be done. Sometimes a sanitary engineer is engaged to advise as to a suitable installation. Again, there are cases in which various kinds of persuasion have eliminated the possibil-

ity of installing anything but one type of plant. Even the well meaning commissioner is just as determined who, in his visit to another city, has seen a certain type of plant accomplish fine results and is firmly convinced that that system alone should be installed in his own city. The plant may give good results, it may give only partial results, and it may not give any results at all. Some plants, improperly designed, have even made the water worse. It is not difficult to point to examples of this, and the reason is obvious when one considers that no two waters are exactly alike or polluted to the same degree. . . .

For the reasons stated it seems advisable to have the State Board of Health approve all plans for new water purification or sewage disposal plants, rejecting any system considered as experimental or which in the Board's opinion will not bring about the desired results. . . . A State Board of Health, with a properly equipped laboratory and with a staff of officials well versed in this work, as well as its other important duties, would be a great factor in helping this work of water purification.

Any place known to have a suspicious supply of water should be under the surveillance of the Board. Samples of water should be taken at regular intervals over a long period. A systematic investigation should be under way at all times, starting with the larger cities unable to make their own investigations and gradually coming to the smaller towns, preference of course being given to those places whose supply is most contaminated or under suspicion. Biological as well as analytical examinations should be made; with this material at hand the work of determining the correct method of purification would be much lessened. The advantage of this method is obviously in favor of the smaller cities and towns which cannot afford to make such examinations or procure expert advice within practicable limits of expense.

NEW ENGINES FOR WILMINGTON

To Improve Delaware City's Filtration Plant—Contract Award for Two 12 Million Gallon Pumps—Description and Equipment

WILMINGTON has contracted with the Holly Manufacturing Company, of Buffalo, N. Y., for the manufacture and erection of two 12,000,000 gallon pumping engines for use in connection with the new filtration plant to be installed there. They are entirely self-contained, as the entire weight of the engine and pumps is supported on three heavy bed-plates, resting on masonry foundations, at the level of the basement floor of the pumping station. Massive iron framing extends from these bed-plates to the engine bases at the level of the engine room floor, permitting any part of the pumps to be removed without disturbing the steam end or necessitating its being held up by temporary supports.

Each engine has three steam cylinders, one high- pressure, one intermediate and one low-pressure, mounted upon the tops of the main frames, which are of the double "A" type.

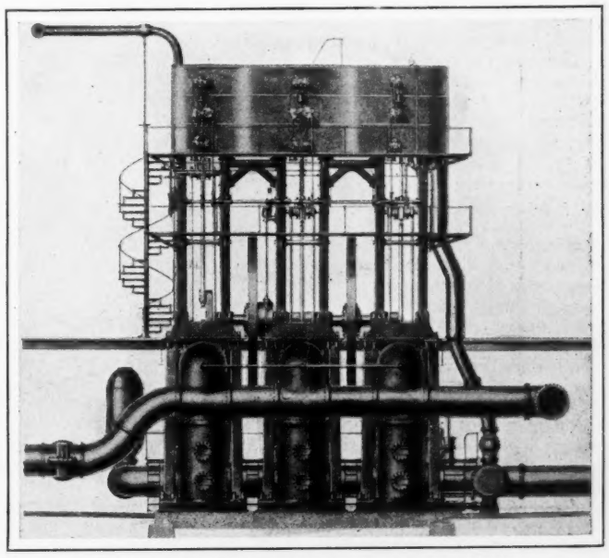
The steam valves are of the Corliss and Poppet type, Corliss valves being used for inlet and exhaust of the high-pressure and for the inlet of the intermediate cylinder with Poppet valves for the exhaust from the intermediate and both inlet and exhaust of the low-pressure cylinder. The inlet and exhaust valves of each cylinder are driven from separate eccentrics placed on a lay-shaft, which is driven by return crank connecting rods from the high-pressure and low-pressure main crank pins. Directly beneath and in line with the center of each steam cylinder is located a single acting outside packed plunger pump, each pump cylinder being flanked by two sets of suction and discharge chambers. The pump valves are of rubber and work on composition seats. They are mounted in groups on removable cages which may be easily withdrawn from the chambers for examination.

ENGINE AND EQUIPMENT

Each engine is equipped with a surface condenser, attached air pump and boiler-feed pump. A primary feed-water heater is placed in the exhaust pipe of each engine between the low-pressure cylinder and the condenser. The speed of the engines is regulated by a flyball governor driven directly by gears on the lay-shaft.

Following is a list of the principal dimensions of each engine, together with a summary of the conditions under which they are to operate:

H. P. cylinder, diameter	28 inches
I. P. cylinder, "	54 "
L. P. cylinder, "	80 "
Pump plungers, "	26½ "
Stroke of all	48 "
Number of flywheels	2
Diameter of flywheels	16 feet
Capacity of each engine, twenty-four hours	12,000,000 gals.
Total head	275 ft. to 285 ft.
Piston speed	200 ft. per min.
Steam pressure	150 pounds
Duty guaranteed, per 1,000 lbs. dry steam consumed by each engine	170,000,000 ft. lbs.



HOLLY HIGH-DUTY VERTICAL TRIPLE EXPANSION PUMPING ENGINE

SOME CITIES' WATER PROBLEMS

Atlantic City, N. J.—The larger question of the rearrangement of our system by providing storage reservoirs and a pumping station in this city should be approved or abandoned before making improvements at Absecon. The purpose of this alteration would be to furnish a certain amount of storage in the city in case of accident to our force mains and at the same time the best and cheapest method of securing an independent system of high pressure service, if desired for fire protection hereafter. The cost of this is estimated at $460,000, including the new pump and boilers.

KENNETH ALLEN, Superintendent and Engineer.

Bridgeton, N. J.—For several years past, during the summer, we have been compelled to use a large amount of water from East Lake, although its use has been condemned by our chemist. It was ordered that the open spring water basin be deepened seven feet by the use of sheet piling, making a collection gallery five hundred feet long. The increased quality of water secured by the deepening of the basin proves conclusively that the money was well spent.

TIMOTHY WOODRUFF, Superintendent.

Boston, Mass.—The first step was taken during the past year toward furnishing an improved L. S. and H. S. supply to South Boston flats by the construction of a tunnel under Fort Point channel, immediately south of Congress street bridge. The tunnel is of brick, in the form of an inverted siphon, to carry a 30-inch L. S. and a 24-inch H. S. water pipe. The shafts are 7¼ feet in diameter with brick walls 16 inches thick; they are inclosed in a steel cylinder ½ inch thick, from their top to a point about 20 feet below the bottom of the channel, and are protected by substantial circular fenders. The horizontal portion of the tunnel, 119 feet long, is circular, 8 feet in diameter, and is lined with 12-inch brickwork; its top is at grade—38, the present bottom of channel being grade—18, and the proposed grade for future dredging being—23. The material excavated was stiff blue clay with sand beams; the work was done under air pressure.

WILLIAM JACKSON, City Engineer.

Buffalo, N. Y.—The public water supply of the City of Buffalo is obtained from the Niagara River, near the center of the stream, about one mile below Lake Erie. The present intake pier is situated about 1,000 feet from shore in a 16-foot depth of water. It was completed in 1874, and has been in exclusive use since March, 1894. This long and narrow structure is built of stone, and the submerged portion is provided with ice shields and openings for receiving the water from the river at various depths from the bottom. The latter are necessitated by the slush ice which in winter is a serious matter in this river, where the current ranges ordinarily from seven to fifteen miles per hour, and where at times the ice fills the river nearly to its full depth. The average stream flow of Niagara River is about 220,000 cubic feet per second

GEORGE W. FULLER, Superintendent.

Cambridge, Mass.—The total length of the recently built conduit from the point where it begins in Arsenal street near Irving street, in Watertown, to the inlet to Fresh Pond is about 12,125 feet. About 11,500 feet are of concrete, five feet three inches in diameter inside; 475 feet are of forty-two-inch cast-iron pipe; thirty-four feet are taken up by the inlet chamber and well, and there are 117 feet of thirty-inch cast-iron pipe making the inlet to Fresh Pond.

FREEMAN C. COFFIN, Chief Engineer.

Concord, N. H.—Attention is particularly invited to that portion of the superintendent's report exhibiting in detail the work of substituting cast-iron distributing pipes for the original cement-lined pipes, and the largely increased capacity of the former.

From the Water Commissioner's Report.

Middletown, N. Y.—I find that the efficiency of the filters varies from time to time between wide limits. This is not due to poor management, nor because sulphate is added in varying amounts through ignorance of the fact, but simply because the filters are overworked. In order to keep up a supply sufficient to meet the daily consumption one thing must be done. The amount of sulphate must be cut down in order to render filtration more rapid. At once the quality of the filtered water becomes sacrificed and at times filtration is very imperfect. It does not seem long before the demand for a larger filter plant becomes imperative. An increase in the size of the clear well would suffice for some time but this would not be the final solution of the problem.

IRVING C. BALL, Chemist.

Newark, N. J.—Previous to the completion of the Cedar Grove Reservoir the distributing reservoirs in the city were supplied from the Macopin Intake. It was found at times, especially after heavy rainstorms, that the water supplied to the city was very muddy, and it was necessary to flush the hydrants frequently, which was not only a source of great expense, but also an annoyance on account of the numerous complaints in regard to roily water. After the water was turned on from the new reservoir the 60-inch steel pipe was filled and thoroughly flushed and the water was sent to the South Orange Avenue Reservoir, supplying the regular and special High Service districts, and also to the Belleville Reservoir, supplying the Low Service districts. Since this was done we have had no complaints in regard to muddy water, which shows that the New Reservoir, as originally intended, is a very efficient sedimentation basin as well as a storage reservoir.

G. SANZENBACHER, Engineer and Superintendent.

Reading, Pa.—The Antietam Filters and the 15,000,000-gallon Allis-Chalmers pumping engine are practically completed. Both are doing service and the minor details of completion necessary to formal acceptance will be completed in a few months. These two improvements add great value to the water-works plant, not alone in the actual cost thereof, but in the greater efficiency secured and the convenience and health of our citizens. The total cost of the works will be over two and one-half million dollars and the actual net debt about three hundred and five thousand dollars. We doubt if there is a city of the size of Reading or near its size, which can point to a financial condition so favorable as this, and a plant so complete and efficient.

From the Water Commissioner's Report.

Schenectady, N. Y.—All the city's water supply during the year has been pumped from this station, and with the exception of the damage done to the transmission line poles by the ice gorge last spring, there has been no accident worthy of mentioning. The difficulty at the time of the ice gorge, while it was serious, was repaired so that the entire close down was of less than two hours' duration. The citizens may feel assured that the plant is fully as reliable as the proposed steam plant would have been, and the cost of repairs will be much less. The buildings, fences and grounds are all in good order.

GEORGE HOLTZMANN, Com. Public Works.

Springfield, Mass.—Cannot longer maintain efficient fire service with its present system. Filtration, as at present proposed, still further decreases the fire protection, and therefore the filtration of our present source carries with it the expenditure not only for the filter plant itself, but for an additional pipe line and the further development of the supply, which procedure would take almost as much time as the development of a new supply. The development of our present sources, even if State permission could be obtained for that plan, would entail the expenditure, to produce satisfactory water, of enough money to procure a supply capable of development to meet the demands of a city four times our present size. Every experienced engineer has advised us not to develop Ludlow, and every experienced engineer has advised us to go to some of the branches of the Westfield River.

Board of Water Commissioners.

St. Paul, Minn.—The rainfall for 1905 was 30.76 inches, considerably above the normal. We have now had four consecutive years of excessive rainfall and as a consequence the water supply from the Vadnais Lake system has been amply sufficient, and there has been no occasion to pump from the Centerville Lake system or the artesian well systems. On account of the failure of the last Legislature to authorize a bond issue for the improvement and extension of our water supply system there has been no money available for any work in this direction and all the improvements recommended in my last report have been obliged to lay over and the principal work done by the Engineering Department has been in furnishing plans, profiles and maps for pipe laying, and making surveys and estimates.

L. W. RUNDLETT, Commissioner Public Works.

Rochester, N. Y.—The works are owned and operated by the city. Two systems of water-works are in use, viz: 1st. A gravity system of potable water. 2d. A direct pumping system, taking water from the Genesee River. The source of gravity system is Hemlock Lake, situated in a hilly district 30 miles south, and about 386 feet above the general level of the city. The quality of water is not excelled, and sanitary measures are in force to maintain the purity of the supply. There are two reservoirs connected with the system; a storage reservoir at Rush, about nine miles south of the center of the city, and 224 feet above the general elevation thereof, having a capacity of 63½ millions gallons; and a distributing reservoir, called Mt. Hope reservoir, situated about two miles south, and about 110 feet above the general elevation of the city, having a capacity of 22½ million gallons.

E. A. FISHER, City Engineer.

New Brunswick, N. J.—It has been the aim of the Commissioners during the past year to increase the supply of water, so that all consumers in all parts of the city could get a sufficient amount for all their requirements. This has been accomplished by the installing of about five thousand feet of twenty-inch main, giving the people a large volume of water and keeping up the pressure in the high parts of the city. This we say has been accomplished. The next important move in the Water Department in the opinion of the commissioners is the installing of a complete and thoroughly up-to-date Filtering Plant.

WM. SCHLESSENGER, Pres. Board of Water Commissioners.

METER MATTERS

What Various Cities Are Doing—Official Reports and Opinions—Saving Money the Problem—Rates and Service

WE present herewith abstracts of reports received from officials of the Waterworks Departments of a number of cities where meters have been installed. In some municipalities they are furnished by the department free; in others the consumers install them for their own protection, different kinds being used. In all cases it is shown that the use of meters has brought about a saving in both water and money.

Battle Creek, Mich.—

Statement and kinds of meters in use, Dec. 31, 1905	SIZES							Sold	Rented	Total
	Register	½ Inch	¾ Inch	1 Inch	1½ Inch	2 Inch	3 Inch			
Crown	..	1120	84	32	10	32	6	187	1097	1284
Lambert	..	357	287	3	1	1	..	59	590	649
Thomson	..	4	181	2	..	..	..	12	175	187
Neptune	..	272	195	1	..	..	..	48	420	468
Nash	..	532	81	..	..	..	..	12	601	613
Hersey	..	2	35	1	..	..	..	6	32	38
Empire	..	17	3	..	..	..	..	1	19	20
Worthington	..	4	..	..	..	1	..	1	4	5
Gem	..	..	..	..	..	..	4	1	3	4
Westinghouse	..	2	1	..	..	..	..	1	2	3
Pittsburg	..	4	..	..	..	..	..	..	4	4
Buffalo	..	1	1	..	..	..	..	1	1	2
Register on Elevator	1	..	..	..	..	..	..	1	..	1
Union	..	1	..	..	..	..	..	..	1	1
Total	1	2316	868	39	11	34	10	330	2949	3279

W. W. BRIGDEN, Superintendent.

Camden, N. J.—I feel that all the water takers have a care in the unwasting of water. Yet statistics taken from other cities show where meters are used considerable saving in water is gained. The number of gallons of water consumed per capita in our city on a basis of 70,000 population, from the 1st of January to April of the present year, shows an average of 160 gallons per capita. I would recommend the adoption of meters in all establishments that are liable to use large quantities of water, except the private dwellings, as I think by so doing considerable saving would be made in the consumption and a larger revenue to the department.

ROBERT HOLLINGSWORTH, Chief Engineer.

Chicago, Ill.—According to a table which is based on the conclusions drawn by eminent engineers after observing facts as they are in other cities, the pumpage, if 9,000 or 10,000 meters are installed each year for ten years, will steadily decrease until, when 40 per cent. of the total number of taps in use have been metered, the pumpage will be a great deal less than it is to-day, even if natural increase in the per capita consumption be considered. It can therefore be seen that very little would have to be expended in extensions of the pumping plants for many years to come, while, if nothing is done to change present conditions, an expenditure of an average of at least $600,000 per year will have to be made for tunnels and pumping plants alone.

JOHN ERICSON, City Engineer.

Cleveland, O.—Over nine out of ten are saving money from meters. Most water departments cannot afford so large a cut in revenues through meters, and avoid it by introducing higher minimums than ours, or charging a much higher rate for the first few thousand feet a term than for quantities in excess of that amount. Fortunately for the Cleveland consumers, the department was able to make lower rates for the ordinary domestic metered consumer, considering free meters, settings, repairs, etc., than is the case so far as known in any other of our large cities. This is true in spite of the fact that, unlike many other places, the department here is no burden on the taxpayer, and, fortunately, receives nothing for the service, worth over $200,000 a year, rendered to the city in fire protection and free water for parks, public buildings, etc.

EDWARD W. BEMIS, Superintendent Water Works.

Danville, Va.—For more than twelve years we have been operating under the universal meter system—every supply metered. It has proved to be very advantageous both to the consumer and the department. The average water rent has been reduced fully 60 per cent., though the department has lost nothing financially. Everyone is allowed an abundance of water, but no one can waste it with impunity, as was formerly the habit of a large number of consumers.

FRANK TALBOTT, Superintendent.

Dayton, Ohio.—The total number of meters in use is 11,107, of which 1,509 were set during the year, and all of which are owned by the department. The total amount of water pumped was 2,297,572,269 gallons, as against 2,297,853,491 gallons pumped in 1903, making a decrease in amount pumped of 281,222 gallons. Although the above figures include 84,210,000 gallons furnished the National Military Home and 1,170 additional consumers, the fact that there was a decrease in the amount of water pumped as compared with 1903 shows well for the meter system in the prevention of waste and the economical use of water.

CHARLES E. ROWE, Superintendent.

Franklin, N. H.—All customers are supplied through meters. The minimum charge is six dollars per year, which entitles the consumer to 2,000 cubic feet during the year. Rentals are collected quarterly. For the first 1,000 feet or less in each quarter the charge is 30 cents per 100; for the excess over 1,000 feet used in each quarter, 20 cents per 100 feet is charged. Upon all quarterly bills exceeding $12.50 a discount of 50 per cent. of the excess over $12.50 is made. *From Water Commissioner's Report.*

Harrisburg, Pa.—There has been a much larger number of meters (677) set this year than any previous one, due, doubtless, to the increase in flat rates being apparently greater than on the meter rents, although the percentage of advance was practically the same. If the placing of meters continues at the same rate it will result in a short time in having practically all the taps metered. Should this result be attained, it will be one for which the city should be thankful, as in this event every consumer would be on an equitable basis and the extravagant and wasteful user would pay his just share for the amount of water furnished. The per capita consumption has been gradually decreasing each year, thereby enabling the department to furnish an increased supply to manufactories without in any way interfering with the domestic consumption.

BOARD OF COMMISSIONERS, Water and Light Department.

Madison, Wis.—During the past year we increased our meters from 3,336 to 3,583, adding six meters to old services. There remain only 120 services without meters. The city furnishes the meters and the meter boxes free. The total amount of water that passed through the meters was 22,126,816 cubic feet, or 165,951,120 gallons, averaging 127 gallons per taker per day. Calculated at six per taker on account of the numerous boarding and tenement houses or flats in the Latin quarter and the large manufactories, brings the per capita per taker to 21 gallons. Only one-third of the total water pumped passed through the meters, and brought the water rents of $28,460.05.

JOHN B. HEIN, Superintendent.

Middleboro, Mass.—

Names and Sizes of Meters in Use

Name.	⅝ in.	¾ in.	1 in.	1½ in	2 in.	3 in.	Total.
Crown	62	9	3	..	1	1	76
Nash	77	2	1	..	..	..	80
Empire	4	1	..	..	..	..	5
Gem	..	..	..	..	1	..	1
Hersey	46	2	..	..	..	..	48
Hersey Disc	77	2	2	..	..	..	81
Thomson	70	2	3	..	..	..	75
Trident	38	..	2	2	..	..	42
Union	2	..	..	..	..	..	2
Columbia	1	..	..	..	..	..	1
King	3	..	..	..	..	..	3
	380	18	11	2	2	1	414

Water Commissioner's Report.

New Bedford, Mass.—The supply here will meet all requirements for many years to come, but our consumption continues to increase, and it may be hard to realize that over one-third of our daily pumpage is lost in tanks and waste and does no one any good. If desired to change for the better, the one weapon necessary to effect the same is a wholesale installation of meters upon supplies known to be wasteful. For many years the 300 and more meters which are annually installed are purchased wholly by a care-taking class. I wish that every time a care taker installs a meter, one might be placed upon the supply of a careless taker.

R. C. P. COGGESHALL, Superintendent.

New London, Conn.—Pitometer measurements show that the average draft per capita per day is about 125 gallons, which is far in excess of the rate for most cities of this size. What portion of this is preventable waste is yet to be determined. Experiments show the lowest draft, between 2 o'clock and 3 o'clock A.M., to be at the rate of about 1,396,800 gallons per day. While a portion of this is legitimate and possibly 40 per cent. is due to small underground leakages, it is possible that at least 20 per cent. of the whole amount flowing into the city is wasted from leaky fixtures or fixtures allowed to run continuously, and as much more could be saved by a more economical use of water for sprinkling lawns, supplying range closets, etc. When meters have been placed on services a saving of from 50 to 75 per cent. has often been noted, and for this reason and for reasons of equity an extension of the meter system is recommended. It is also recommended that further experiments be undertaken to determine the location of the larger sources of wastage.

W. H. RICHARDS, Engineer and Superintendent.

WATERWORKS MATERIALS AND APPLIANCES

Importance of Selection and Maintenance—Pumping Machinery, Conduits and Meters—Qualities of Different Varieties, and Their Uses—Well Screens, Filters and Other Appurtenances.

THE selection of materials used in the construction of a waterworks, including pumping machinery, and in their maintenance, are matters of great importance to a large number of our readers, and we have endeavored to give a brief statement of the various more important classes of materials. The information is obtained largely from the manufacturers themselves, and is believed to be reliable.

Pumping Machinery.—Probably there is no part of a plant the selection of which calls for more judgment than the pumps. These may be reciprocating, either direct-connected, fly-wheel, or power; centrifugal, either single or multiple stage; and rotary and other types are used less generally. There are also used hydraulic rams, pneumatic pumps, air-lift plants, etc., which perform the services of pumps without actually being such in the general acceptance of the term.

Reciprocating, direct-connected pumps can be obtained of a capacity from a small "boiler feed" up to two, ten, twenty million gallons per twenty-four hours. The duty generally is increased with the size, running well above 150,000,000 foot-pounds in certain important plants, although it may be as low as 10,000,000 foot-pounds. The head pumped against may be almost anything up to say 1,000 feet. These pumps generally have two steam and two water cylinders, the discharge thus being made more nearly continuous.

Fly-wheel Pumps and Hydraulic Rams

Fly-wheel pumps are used of large capacities only; cannot be cheap pumps, and therefore should be of high duty. Power pumps may be connected by either gear or belt to motors, using either electricity, gas, gasoline, steam, water power, etc. They may consist of one, two, or three water cylinders (probably the last is most common), the increase of number being intended to secure uniformity of flow as well as increased capacity and efficiency. They may be obtained of a capacity up to 5,000,000 gallons per twenty-four hours, but this is probably exceptional, most of them running much smaller. A reciprocating, cam-action pump manufactured on the Pacific Coast claims to secure pulseless action with a capacity up to 1,750,000 gallons daily. Centrifugal pumps have but recently come into use for high lifts, or giving high duties, but are now made for heads of 500 feet and over, and with capacities up to more than 200,000,000 gallons per twenty-four hours, and showing an efficiency of 50 per cent. to 80 per cent. of the applied power. They may be belt, gear, or direct connected to any kind of motor. They claim ability to pump any kind of liquid or semi-liquid, and the advantage over reciprocating pumps of having nothing to clog or get out of order, no valves, springs, or other small moving parts.

Hydraulic rams have been used many years for small services and low lifts. At least one company is now manufacturing a ram, however, up to a capacity of 1,000,000 gallons per twenty-four hours, claimed to lift up to 500 feet height, and to develop an efficiency of 80 per cent. to 90 per cent. Over 5,000 of these are said to be in operation.

Compressed air is used for raising water by means of a "pneumatic displacement pump," or by the "air lift." The compressor may be driven by any power available, and be at a distance from the point where the water is raised, at which point no attendant is necessary. These are used especially for lifting from deep wells.

Conduits.—The pressure conduits in most common use for water, in the eastern and central parts of the country at least, have been made of cast-iron, but steel and iron sheets, wood, and concrete have been used in all parts of the country. In buildings and exposed locations flanged cast-iron pipe is common; but under ground the bell and spigot lead-jointed pipe is standard. This is cast of all diameters up to 60 inches, although more than 30 inches is exceptional. Foundries which cast pipe are found in almost every section of the country. A special machined joint which relies for tightness on the ends fitting snugly when drawn up by bolts is now being introduced, and claims speed and cheapness of laying and that the tightness of the joints is not affected by temperature changes.

Sheet-iron or steel pipes can be made much lighter than cast-iron for a given required strength, one of their advantages being the convenience of transportation by mule or otherwise over difficult routes. They can be made in sections of any length; or can be built up on the ground from shop-punched plates. The sheet may be in a continuous ribbon (spiral), may have its two edges united in one longitudinal joint, or there may be a number of rectangular plates joined together. The smaller pipes are either welded or riveted; the larger are generally riveted with either butt or lap joints (but some are welded; and a "locking-bar" has been used in a few cases). They have been made of all sizes up to nine feet diameter or more. The end joints may be riveted, or flanges or collars and sleeves for lead joints may be attached to them. They have been used in all parts of the country, but especially in the Atlantic and Pacific Coast States.

Strengthening Water Pipes

The first water pipes were bored logs, but these could stand little pressure; the logs are now turned true on the outside and strengthened with steel bands. The end joints are mortise and tenon or socket, or with cast-iron or steel collars. For larger sizes wood-stave pipe are used, built like an endless barrel of uniform diameter. The staves are

held together by steel bands cinched up tight; the ends of the staves are joined by oak or steel tongues. These are built on the ground, the staves being easily transported in bundles of any size. They may be built to quite sharp curves. Wood pipe are claimed to be cheaper than iron, and more durable, unaffected by acids or alkalies, electricity, heat or cold, and to discharge more water for a given diameter than either cast-iron or steel. They have been made up to ten feet or more in diameter, and for heads up to 500 feet. The large sizes are made almost exclusively on the Pacific Coast; the smaller sizes both East and West.

Concrete-covered steel plates are used, but not nearly as much as formerly. Reinforced concrete for conduits of three feet diameter and upward is claimed to be water tight when properly made, and be everlasting against ordinary destructive agencies.

Water Meters.—There are half a dozen or more manufacturers each of which turn out perfectly reliable water meters. The majority of these make the so-called disc meter, which seems to be the most sensitive to small flows; one makes a rotary; another a duplex piston; and several make "current" or "velocity" meters for large flows. For 50,000 gallons a day and upward there is a meter of an entirely different type, with no moving parts, but relying upon variations in pressure head to indicate the velocity of flow. A meter may be placed on a by-pass so connected that a fixed percentage of the total flow passes through it; and a modification of this idea is used as a "detector," which measures small flows and indicates the existence of large ones.

In the disc meter a round disc is caused to "wobble" systematically by the water passing through, and by this motion, acting on a system of gears, moves the register. In the rotary a star-shaped piston is so moved in a horizontal plane by the passing water as to drive the gear. The duplex piston meter is similar to a duplex pump, the plungers moving the recording register as they are displaced by passing water. The "current" or "velocity" meters are similar to turbines, the number of revolutions being a function of the volume of water passing through.

Difference in Meters

The differences in the disc meters are largely in details of material and workmanship; but one claims as a special feature a bottom which either yields, or breaks in an unimportant part, if the water in the meter freezes, preventing damage to the rest of the meter. The piston meter claims special accuracy and durability. The pressure-head meter claims unlimited capacity, absolute indestructibility, and minimum reduction of pressure.

Space will not permit of even a reference to scores of other materials used in water works construction and maintenance; well screens, points, etc.; well driving machinery; mechanical, rapid, or coagulation filters; special grades of sand for both these and slow filters; stand-pipes, tanks, etc., screens and other appliances for reservoirs; valves and hydrants; pipe cutters, tappers, etc., and many other appliances may be found in our advertising columns.

SPRINGFIELD'S NEW FILTERS

Sand Variety for Clarifying Water Highly Polluted with Anabaena—Difficulties Overcome—Investigations and Results—Description and Data

By ELBERT E. LOCKRIDGE,
Assoc. M. Am. Soc. C. E., Engineer Water Department

In the water supply of Springfield, Mass., a peculiar situation existed last fall. In 1873 the city of Springfield, with a population of but little more than 26,000, took as a water supply some small brooks in the town of Ludlow, which have since become famous among water supplies, and are generally known as the Ludlow system. Reports of this date, as well as the newspaper comments at that time, indicate that this supply was taken not because it was thought to be the best supply available, but because it could be developed cheaply.

The main reservoir was formed by damming two valleys and flowing what was known to the old residents as Dark Island swamp. This gave a very shallow basin of water with a bottom covered very largely with a black organic mud. The records of the Department show that almost immediately after the construction of this reservoir marked tastes and odors were noticeable in the water. These tastes and odors were caused by vegetable growths, and the cause, at least during recent years, of the particularly disagreeable water in the Ludlow reservoir, has been a growth of anabaena. During recent years this has been so plentiful as to make the water unfit for use for at least nine or ten weeks of each summer.

Water from Surface Ponds

In order to furnish as palatable water as possible during the summer the city has been obliged to establish pumping stations on three surface ponds, and these are used only during the season when the reservoir water cannot be used. These ponds make up the deficiency in water needed to supply the city above the summer flow of the brooks. This pumping is not only a heavy expense, but also necessitated the use of the unstored brook water, which, of course, could not be rendered perfectly safe from water-borne disease germs.

The water supply question has been the live issue of the city of Springfield for several years. It was realized that the present, or Ludlow system, was thoroughly unsatisfactory in quality and that the city was fast approaching the point where the quantity would be insufficient. The available streams of the vicinity were, however, so thoroughly utilized for power and the interests affected were so many and varied that every attempt to secure a new supply has been defeated by the Legislature of the State.

In the study of the question of a new supply, several engineers of note have been employed and a considerable sum of money has been spent in experiments and investigations. In 1902 Mr. Percy M. Blake, C.E., after operating in conjunction with the State Board of Health a number of filters at varying rates at the Ludlow reservoir, reported against any further development of the Ludlow

supply. One reason for this was that all the rates of filtration had been unsuccessful at some period during their operation. Mr. Blake recommended that a new supply be taken. The Huntington branches of the Westfield river which were asked for at that time for a new supply were refused, and in 1902 the City Council appointed a special commission to employ expert engineers "to make a thorough investigation of the entire question of a municipal water supply for the city of Springfield." Mr. Samuel M. Gray, M. Am. Soc. C. E., and Mr. George W. Fuller, M. Am. Soc. C. E., were employed. Under their direction the writer was engaged to make special studies of the possibilities of filtering the Ludlow supply, and in this study twelve filters were operated during the anabaena season of 1903.

Report of Engineers

Following this investigation these engineers reported that with double filtration and triple aëration it was probable that a palatable water could be obtained; but inasmuch as more and better water could be secured more cheaply from other sources, they could not recommend that procedure. The city then again petitioned the Legislature for the right to take water from the Huntington branches of the Westfield river. This right was again denied.

Following these several defeats the City Council, realizing that more and better water must be obtained, appropriated $300,000 for the construction of sand filters at the Ludlow reservoir and Messrs. Hazen & Whipple were employed to design these filters. After a study of the situation, Mr. Allen Hazen, M. Am. Soc. C. E., reported that a filter at that cost would not be successful during all seasons and further reported that the loss of head necessitated by the operating of such filters would render the capacity of the main pipe lines inadequate for the fire protection of the city. This brought the whole question of the new supply once again before the city. Many citizens, discouraged by past defeats, believed that rights would not be granted for any new supply, and that it was the duty of the city to fully develop, even though the development was not economical, the water shed owned by the city. Other citizens believed the Ludlow system capable of greater development than that shown by the reports of the engineers and experts. On the other hand, probably a majority of the people were thoroughly dissatisfied with Ludlow water and were unalterably opposed to spending any more money on the present system.

Mr. Hazen, in looking about, developed the possibilities for a water supply of the Westfield Little river, another branch of the Westfield river, and an admirable site for a water supply.

Results of Investigations

The situation, then, in the fall of 1905 can be summed up in this way. Every attempt to secure a new supply had met with failure. Every engineer had recommended against the further development and filtration of the Ludlow supply. A typhoid epidemic during the summer of 1905, while in no way due to the water, had its influence in the demand that something be done to improve the quality of the water of the city.

After a long debate it was decided by the City Council that the Board of Water Commissioners be instructed to attempt to secure legislation to obtain the water of Westfield Little river for a new supply, and that a temporary filter on the old supply be constructed at once to improve the quality of the water, regardless of the question of the future supply. The intermittent filter, now in process of construction, was therefore designed. This filter is of much cheaper construction than had previously been suggested or is ordinarily planned, and had the advantage that it could be constructed during the winter and spring and would be ready for the anabaena period for the season of 1906. This arrangement insured better water from the present system, and by constructing the filter above the elevation of the reservoir obviated the difficulty of the loss of pressure.

New Supply to Be Secured

The agreement to thus far develop Ludlow during the time when the attempt was being made to secure a new supply brought together all factions and unanimous consent was obtained to petition for the Little river, and, this being secured, the friends of the new supply gladly embraced the opportunity to secure better water from Ludlow in the interim. This spring the Legislature has heeded the city's request and the rights to the new supply have been secured, and it is hoped that the intermittent filter now under construction will render Ludlow water usable until an ample supply of excellent water is obtained.

Designs for the intermittent filters were prepared at once by Messrs. Hazen & Whipple, the preliminary grading was started at once, and the construction carried on through the winter.

It may seem, from what has been written, that the object of these filters is to secure for the city safe water during the period when the main storage reservoir is entirely unfit for use. During the other seasons of the year the city is supplied with water from this reservoir with a capacity of 1,600 million gallons, which would in itself, to a considerable extent, insure safety from water-borne diseases; and inasmuch as the water to be applied to the filter is from this same large reservoir, the sanitary question need not be considered to the same extent as is ordinarily necessary in filter design.

Object of Filter

The object, then, of the filter is primarily to render a water deeply opaque with anabaena for two months or more each year usable, where otherwise water pumped from the smaller ponds and unstored brook water would, of necessity, be used. In this feature it is probably unique, as under ordinary circumstances filters are constructed to give large bacterial removal results, and to improve the sanitary quality of the water.

The filter itself is practically four acres in extent and is situated on a peninsula lying between the main reservoir and a small intake basin from which the supply is carried to the city by gravity.

In construction the filter is simple. There is no concrete bottom and there are no division walls. The floor or sub grade of the filters is of the soil encountered in excavation. It is divided into four beds each of slightly less than one acre. The water is pumped through a 36-inch cast-iron pipe and 30-inch discharge pipe to the center of the filters, from where it overflows into a concrete basin 30 feet in diameter and divided into four sections, and so arranged that water can be turned into any one or more of the filters.. Surrounding this central basin is a concrete apron 10 feet in width on to which the water is delivered. Surrounding this another concentric ring of 10 feet is paved with loose stones. This makes a central disturbing system and aërator 60 feet in diameter.

Filters and Pipes

The extreme length of each filter bed is 250 feet and the entire area is covered with under drains of 6-inch and 8-inch Akron tiling laid with open joints, a ¾-inch opening being left every two feet, the filing being laid in lines 12½ feet apart. There are altogether 13,000 lineal feet of this pipe. These tile drains lead to a central concrete drain 56 inches high and 30 inches in width, inside dimensions. This main concrete drain passes across the center line of the filters, dividing the area into halves, with two filter beds on either side, and carries the water delivered to it by the tile under drain to a wooden flume, which in turn delivers it to the old intake basin, which is now to serve as a clear-water basin. These pipes are surrounded with graded gravel, over which is laid five feet of sand taken directly from a bank which adjoins the filter site. This sand is all selected by analysis, and the aim has been to keep its effective size at least as great as .30 mm. The bank is admirably adapted for this purpose, and the amount of waste from the bank due to the encountering of the sand too fine has been so small that little more than that necessary for embankments has been moved.

It is planned to operate the filters intermittently, turning the water alternately on filters Numbers 1, 2, 3 and 4. It is also planned to do all of the pumping during sixteen hours, so that the operation will in no case be continuous.

Anabaena Cells Use up Oxygen

It may be stated in this connection that the anabaena cells, frequently present to the extent of several thousand per cubic centimeter and composed entirely of organic matter, during filtration quickly use up the dissolved oxygen in the water. In all the filter experiments carried on with this water the filters operated at too high a rate allowed the anabaena to pass through the sand, while with the lower rates of filtration the oxygen content of the water was entirely exhausted and the odor remaining in the water was even worse than that of the reservoir. This latter odor was, however, largely removed by aëration. This filter was therefore so constructed that the raw water is aërated on entering the filter and the filtered water is aërated on leaving the filter, and with the intermittent operation a considerable volume of air can be brought in contact with the water.

Under ordinary circumstances it is not necessary to lift the water more than eight or ten feet; but when the reservoir is drawn low it may reach twenty-five feet.

The pump and engine is a steam turbine and double centrifugal pump on one base, manufactured by the D'Olier Engineering Company, and has a rated capacity of 14,000 gallons per minute.

Pumping Station and Laboratory

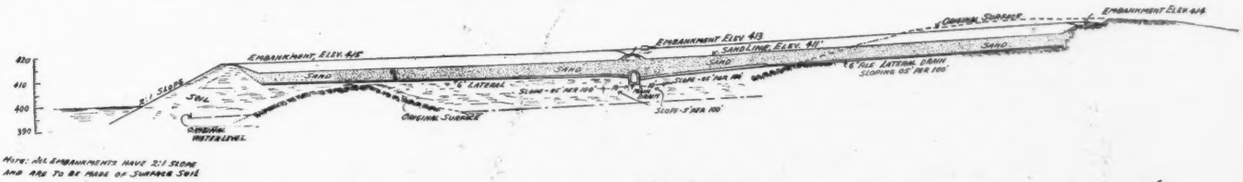
The pumping station and the pump house is divided into three rooms, in one of which are two 70-horsepower boilers. The steam turbine and other pumping machinery are located in the second room, while the third room, which is entirely cut off from the remainder of the building, is to be used for the office and laboratory.

The contracts for the filter work were divided into several sections. First, the preliminary grading, which was to be carried on through the winter. This winter work was rendered necessary by the necessity of early completion. Thirty-six thousand cubic yards were moved in preparation of the base for the filters at 29¾ cents per cubic yard. F. T. Ley & Co., of Springfield, were the contractors for this as well as for the placing of the sand in the later contract.

Letting of Contract

The placing of the filter sand, laying of the concrete drain and concrete foundations, and the laying of the tile drains were included in the second contract and 40,000 cubic yards of sand were necessary, for which 22 cents a yard is to be paid.

The larger part of this has been moved by a steam clam shell bucket loading a train of ten cars, each with a capacity of about 3½ cubic yards. The track was kept at the edge of the fill, so that the sand was dumped into its proper place without second handling, and the final grade was secured at once. Separate contracts were let for the driving of the piles necessary for the outlet flume, laying of the intake pipe, and the construction of the pumping station and laboratory. The filter was ordered by the City Council November 21, 1905, and is under contract to be completed July 1, 1906.

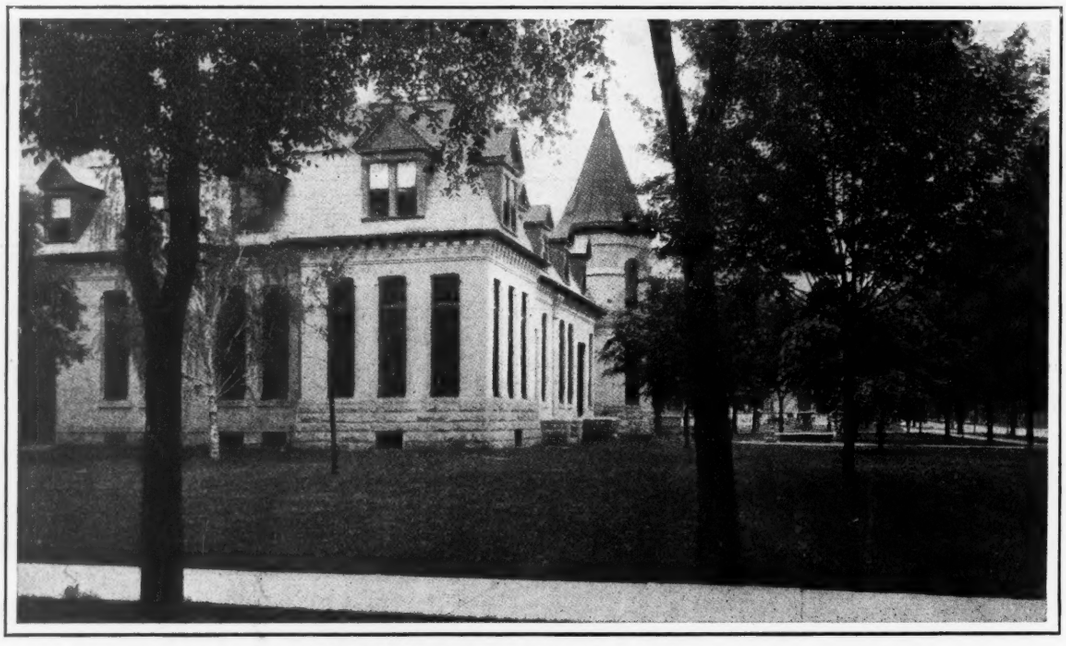


NOTE: ALL EMBANKMENTS HAVE 2:1 SLOPE AND ARE TO BE MADE OF SUITABLE SOIL

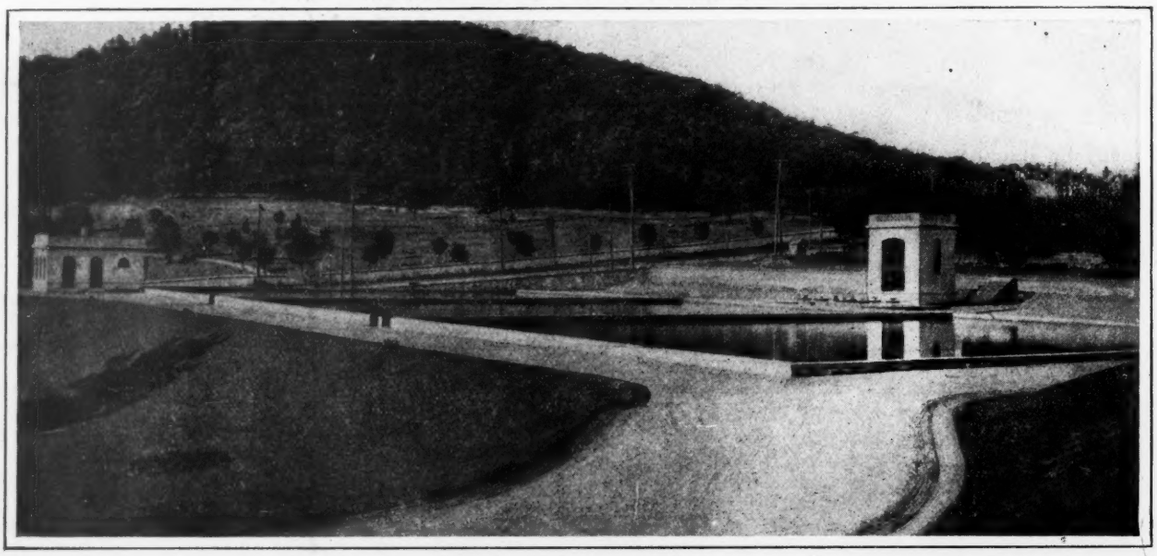
WATERWORKS SAND FILTER

SOME ARTISTIC EFFECTS IN WATERWORKS PLANTS

PAYSON PARK RESERVOIR, CAMBRIDGE, MASS.—SHOWING DIVISION WALL



WATERWORKS PUMPING STATION, MADISON, WIS.



ANTIETAM FILTERS, READING, PA.

WHO'S WHO IN MUNICIPAL WORK

BECKER, Sherburn, H., Mayor of Milwaukee, Wis., born in Milwaukee 29 years ago, educated in public schools there and at Boston, Mass., and entered Harvard University. Entered Marine National Bank, Milwaukee. In 1902 was elected supervisor. Is president of the Hansen-Schmitt Tobacco Company. Married Miss Irene Smith. Residence, Prospect Avenue, Milwaukee, Wis.

DAVENPORT, Ward P., Civil Engineer, Superintendent Plymouth Water Co., Plymouth, Pa. Was born in Plymouth, Pa., February 27, 1870. Councilman since March, 1904. Obtained degree C. E. Cornell, 1893. Residence, Church Street, Plymouth, Pa.

GINDER, John, Street Commissioner, Trenton, N. J.; born Trenton, N. J., 1855; educated Trenton Public Schools; worked at the trade of sanitary potter many years; entered politics at an early date, elected Republican Freeholder in an overwhelmlingly Democratic ward in 1888; elected to State Legislature from an almost hopelessly Democratic gerrymandered district in 1893; re-elected by an unprecedented majority in 1894; appointed Street Commissioner in 1894; re-appointed in 1897, 1900 and 1903; present term expires 1907; member of Republican Club, Order of Elks, and Republican County Committee; president of the Trenton Turkish and Russian Bath Co.; president of West State Realty Co. Residence, Spring Street, Trenton, N. J.

HUSTON, R. C., Civil Engineer; was born in Indianapolis July 2, 1876. Educated in Cincinnati, Ohio. He received private instructions in civil engineering under Colonel J. T. Foster, for many years county surveyor of Cook county, at Chicago. This extended over a period beginning June, 1890, and ending June 1894. He was assistant in the engineering office of Alexander & Hill, of Chicago, during 1894 and 1895, during which time the sewer and street work in La-Grange, Willmette, West Pullman, Maywood, Rogers Park and Lake Forest was completed. He was assistant engineer to Colonel Foster in 1896 upon the sewer and water-works system at Desplaines and at Franklin Park, Ill., with considerable private work in Chicago. He practiced engineering in Chicago from 1897 to 1903, during which he held the following positions and completed the work, including that of engineer and surveyor for the Board of Education, acting county surveyor for three years, town engineer of Desplaines and Arlington Heights, consulting engineer for the firm of Nash & Dowdle, public works contractors on a part of the intercepting sewerage system of Chicago and Cicero, aggregating a total cost of three-quarters of a million dollars. Mr. Huston has designed and supervised the construction of the water-works and sewerage system at Edison Park; street work and sewers at Arlington Heights and water-works at South Wilmington. He designed and contracted for the construction of an intake for the city of South Haven, Mich. This consisted of the laying of a 20-inch cast-iron pipe under thirty-five feet of water and in a four-foot ditch. Also a receiving well on the shore and at the crib. Some of his big contracts included 65,000 square yards of brick pavement at LaCrosse, Wis. This was until that time (1900) the largest single contract for this character of work let in the State and was completed in the shortest length of time. The records on the work are as follows: Total, 65,000 square yards, consisting of 10,000 cubic yards concrete, 2,515,000 paving blocks, and 10,000 barrels of cement. The work was completed in one hundred working days. The record for one day was 1,004 square yards of concrete and 1,100 square yards of brick. The stone for the work was quarried and crushed by Mr. Huston. He also completed the street work at Morgan Park, Ill. He prepared bids for contracting firms at public lettings in Chicago, St. Louis and Sault Ste. Marie, aggregating $2,500,000. He reported on the following work in 1903: Water-works at Beaumont, Texas; electric light and railway at Natchez; electric light and railway at Jackson, Miss., and Baton Rouge, La., and water-works at Fort Smith, Ark. Since going South he has designed and constructed electric light and power station at Laurel, La., electric light and water-works system at Carrolton, Miss., water-works at Lumberton, Miss., Mt. Olive, Miss., and Indianola, Miss. On January 1, he was elected City Engineer of Hattiesburg. Is the author of "Water Works for Small Cities and Towns." Is vice-president of the American Public Works Association, a member of the Western Society of Engineers and a member of the Illinois Society of Engineers and Surveyors. Residence, Hattiesburg, Miss.

LEISEN, Theodore Alfred, M. Am. Soc. C. E., Chief Engineer of the Water Department, Wilmington, Del. Born at Philadelphia, Pa., February 17, 1864. From 1883 to 1890 engaged in surveys for and construction of railroads in Colombia, South America; 1890 to 1893 First Assistant Engineer in Charge of Sewerage System, Wilmington, Del.; 1893 to 1903 Chief Engineer of Park System, Wilmington, Del., and from 1903 to date Chief Engineer of Water Department, Wilmington, Del. Designed all works for the extension and filtration of the Water Supply for Wilmington, Del., and at present time engaged in construction of this plant. Works now under construction include over thirty-five million gallon reservoir, twenty thousand feet of 43-inch and 48-inch mains, a reinforced concrete bridge 268 feet long for carrying 48-inch main across the Brandywine creek, and new pumping station containing two twelve million vertical triple expansion pumping engines. Residence, 2204 Grepin Avenue, Wilmington, Del.

FINNEY, James A., the present Mayor of Boise, Idaho, was born September 29, 1835, in Franklin County, Ohio, son of Charles and Sarah G. Pinney, of old New England stock; educated in the public schools at Iowa City, Iowa; crossed the plains with his father to California in 1850; went to southern Oregon in 1853; followed packing merchandise from the coast on into the interior until 1861; with train of mules came north into what is now Idaho in 1862; opened store with general assortment of mine supplies in 1863; was appointed Postmaster at Idaho City in 1864 under President Lincoln's administration; was Postmaster in Idaho City until July, 1872; resigned to go into book and stationery business in Boise City; was elected Mayor of Boise in July, 1881, in 1883, in 1889 and again in 1891; was elected for the present term, July 1905; this will be ten years for him as Mayor of Boise. Residence, Boise City, Idaho.

WRIGHT, John A. Collier, attorney-at-law, born in Binghamton, N. Y., August 7, 1859, son of Thomas David Wright (Young Irelander '48, partner of Daniel S. Dickinson) and Helen Stuyvesant, daughter of John A. Collier and Elizabeth Ann, daughter of Lewis Lee Morris, of Butternuts, N. Y.; educated under governess at his Uncle Rutherford Morris', St. John's School, Manlius, Reed's School, Rochester, N. Y.; graduated Harvard College, '81, degree Cum Laude; studied law with W. F. Cogswell, Rochester, N. Y.; lawyer by profession; married November 22, 1900, Emily Roland, daughter of Thomas and Fannie (Rittenhouse) Hyde, Washington, D. C. Secretary of St. Paul Society, organized and secretary Harvard Chess Club; cups and medals, bicycle races. Member of the Harvard Union; Harvard Club (and vice-president), and University Club, Washington, D. C.; charter member Genesee Valley Club Country Club and Polo Association of Rochester. Was a member of the Reform Club of New York until this year, made addresses under its auspices; organized and secretary Citizen's Tariff Reform Association; organized and treasurer Flower City Democracy, and various civic associations; candidate for alderman, special election, Sixteenth ward, Rochester, against Mertin E. Lewis. Devised detailed scheme for National League for Good Roads, organized and was secretary of New York State League for Good Roads and State Highway Improvement Association and State Farmer's Congress, to 1898; appointed delegate to National Farmers' Congress, Atlanta, 1895, by Governor Morton. Vice-president National Road Parliament there; chairman resolutions, Asbury Park National Road Convention, 1894. Committee to Collate State Laws, Good Roads Congress and Agricultural World's Fair, Chicago, 1803; obtained exhibit therefor from Agricultural Committee of H. of R., 1892. Author of the Good Roads Laws in New York, spent fifteen years since 1891 in their procurement and perfection. Member at large, Committee on Resolutions, Cleveland International Deep Waterway Association, 1895, and appointed vice-president thereof for New York. Allied with Public Highways, instrumental in perfecting taxation and bonding schemes of New York, adjusting ways and means of the commonwealth. The co-operative plan of the Good Roads Law, adopted to Grade Crossings abolition, and suggested for River and Harbor and Canal Improvement and Forestry, solving whole highway problem, largely secured deferred local assessments for street improvement and cessation of mortgage taxation as personalty and was foremost in kindred movements.

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NEW YORK, JULY 4, 1906.

CONTENTS

Public Water Supplies and Pollution of Rivers

Two serious problems confront the waterworks superintendent and engineer—where to obtain sufficient water to meet the increased demands, and what to do about the question of purity. In the arid West and Southwest the first problem alone, uncomplicated by the second, causes enormous expense for transportation from distant sources; and the total supply is so limited that conflict of rights to appropriate it are calling for special legislation.

In the East, however, the troublesome question is the one of purity. There are few communities that cannot find water almost at their very doors, but its quality becomes yearly worse. In the oil regions, for instance, many streams are so polluted by leakage from wells as to be impossible for drinking and undesirable even for boilers. There is hardly a stream of any size but receives sewage pollution. During the past year three communities on the Delaware river have each occupied the dual rôle of plaintiff and defendant—the former as water users, the latter as river polluters—their complaint being, "Our neighbors are polluting our only source of supply;" their defense, "What else can we do with our sewage?" It is apparent that there are both rights and duties involved in such cases, but just what they are is not so clear. Has every city the right to perfectly safe water in the stream which flows to it? Has it a right to discharge crude sewage into such a stream? It cannot possess both these rights if other cities along the stream possess them also. Is it its duty to discharge into the stream no water not perfectly safe? (Perfectly pure is, of course, impossible.) Undoubtedly the delay of many States in controlling stream pollution is due to the fact that there is no consensus of opinion, even among any one profession or class of citizens, as to the limitations of these rights and duties.

The common law says that every riparian owner must permit a stream to leave his property in the same condition as he found it. If this could be enforced to the letter there would be no necessity for most of the water filters which cost our cities so much to construct and maintain. But is it desirable to enforce it? If every city along a certain river took its drinking water from and discharged its sewage into it, which would be its cheapest plan, to change its sewage to a potable effluent, to discharge crude sewage and filter highly-polluted river water, or to partially purify the sewage and filter slightly polluted water for the public supply? The answer would not always be the same, but it seems to us that the answer to this is the answer to the question of relative rights and duties. It also seems safe to assert that the answer will almost never imply the duty to discharge only potable effluents; for a study of sewage purification, the dilution and self-purification of streams, and water purification leave little doubt that the transference of sewage into safe potable water can be effected much more economically and certainly by the three-fold process than by the sole agency of any sewage purification process or combination of processes yet discovered.

It is our opinion that until a satisfactory substitute for water carriage of sewage is discovered, the greatest sanitary benefit as well as economy will result from so purifying sewage as to produce an effluent which shall never be putrefactive and filtering the river water for a potable supply. The water company would be justified in increasing the water rates to cover the cost of this purification, but there would be a net saving to the people in the lessened cost of sewage purification which should otherwise be required of them.

Barren Island Barrener

Now that this place has gone up, by its own volition, at a cost of, estimated anywhere from $1,000,000 to $1,500,000, it may not be presumptuous to inquire what New York City is going to do for a substitute. Is it going to reerect the nuisance as it originally stood or abolish it altogether? If the latter plan is followed, this will cause endless delight to all the inhabitants near the Long Island shore, from below Arverne to above Edgemere, which portion of shore has been the dumping ground for the overflow and dropped-overboard refuse for some years past. It has been no uncommon thing for the bathing fraternity using the shore to frequently encounter and come in personal contact with large masses of cocoa fiber matting, traveling trunks, bedsteads, packing cases and the thousand and one whatnots that have managed to escape the dump heap on the island and float landwards. On one Sunday afternoon some few years ago, no less than 39 bedsteads, 26 trunks, 85 packing cases, 70 odd articles of furniture, scores of undefinable other things, varying from shoes to portions of pianos, and over 300 empty bromo seltzer bottles were collated and counted by an enthusiastic statistician friend, who had interested himself in the subject, as having been deposited on the mile or so of sea front between the two places above mentioned, thus disfiguring both the land and the sea scape and giving an ever-striking object lesson as to how things should not be done. Matters in this regard became modified later, but from recent reports received—since the fire—numerous articles of a similar unattractive description are again littering the sands and causing considerable consternation among the inhabitants in spite of the assurance that if the refuse was dumped 20 miles away, the nuisance would be abolished. If it were dumped 100 miles out, this would make little difference, as the floating portions of the garbage would eventually reach the land. What is to prevent New York City making some arrangement, say with New Jersey, to erect a sightly, odorless, spacious plant somewhere in the meadows, reaching the same by a canal cut through the center, using the incinerated refuse as power fuel, and at the same time filling in the thousands of existing useless swampy acres in that State with the ashes, and by these means, in course of time, not only killing off every mosquito, but making into good ground a huge tract of noisome, noxious territory which would, if properly treated, give a fair return for the money invested, apart from a supply of power of almost enough magnitude to work all the near-by cities' works and factories? Surely such a desirable solution of a decidedly unpleasant difficulty could be secured and an end put to the present disgusting menace.

Carelessness as a Crime

THERE were in Greater New York last year 7,750 fires, a larger number than in any preceding year, and of these more than 3,000 were caused by carelessness. In another community, where 5,700 fires occurred in the course of a year, carelessness is assigned as the cause in 1,841 cases—carelessness with matches causing 1,017; carelessness with candles and tapers, 327; with cigars, pipes and cigarettes, 312; with fireworks, 88; by placing ashes too close to woodwork, 20, and with cooking, 77. Many others, started by upsetting lamps, gas and oil stoves and by explosions in the kitchen, can also be assigned to carelessness. These are figures which might well startle one; they should do more, however; they should cause each and every one of us to stop and ponder. Why should there be such thoughtlessness and utter disregard? In every city, not to mention the warnings sent out by the fire insurance companies and the State officials, notices are sent out urging caution on the part of housekeepers and others. But these apparently pass by unheeded. Citizens do not appear to realize the great danger to their own and other property, and of the danger to the life and limb of the firemen and of the residents in the vicinity. Notwithstanding the efficiency of the Fire Departments, the losses mount up into the millions and scores and scores of lives are sacrificed every year—aye, even every week, or every day, through sheer carelessness. It is well-nigh time more care and precaution should be exercised in the premises; and there is apparently no reason why there should not be regulations or ordinances to bring about this desired end. Let other city officials, as well as those of the Fire Department, give the matter consideration, and there is little doubt that the number of conflagrations will be greatly lessened.

How to Reduce Light Bills

THE moral effect of the power of a municipality to check corporate greed without actually investing a dollar is well illustrated in the light bill of Baltimore, Md. From 1890 to 1900 the cost to the city per arc light was $127.75 per year. This was considered excessive and the city secured from the Legislature power to construct a municipal lighting plant at a cost of $1,300,000. The price per arc light was at once reduced to $99.92, and the city has never erected the plant. In 1905 further competition entered the field and the price dropped to $67.49 per arc light.

Police and the Public

MR. STEPHEN O'MEARA, recently appointed Police Commissioner of Boston, Mass., by Governor Curtis Guild, Jr., to succeed the triumvirate board legislated out of office by the General Court, has made an excellent start upon assuming office, has jumped into the good graces of the members of the police force and won the esteem of citizens generally. His attention was called to a complaint against one of the veteran members of the department whom it was charged had insulted a citizen who had thoughtlessly violated one of the city ordinances. He sent an invitation to the officer to call in citizen's attire at his hotel after office hours. There, as man to man, he told of the grievance which had been filed and the officer admitted that the facts were substantially as had been reported. The Commissioner complimented his subordinate for his frankness and truthfulness and suggested that he communicate with the citizen and apologize. This was readily acceded to and it had the desired effect, the

charge being withdrawn. The Commissioner also took occasion at the time to administer a lecture to the officer which it might be well for policemen generally to bear in mind. "You have a right to arrest, or to summon into court, a man who violates the law," he said; "you have a right, under certain conditions, to strike a man, to knock him down with your club, to search him, to lock him in a cell; in a great extremity you have a right to kill a man; but under no circumstances, whether in manner or by word of mouth, have you a right to insult man, woman or child." This is good logic, and sound advice; there is no reason why a policeman, clothed with a little authority, should become insulting. It is possible that a certain element, knowing of the attitude of the Commissioner, may be apt to take advantage of the ruling, but the great majority, we venture to say, will see the justice and equity of his action and applaud his stand in the matter.

The Perforation of Panama

IT is not because we have been lacking in interest on the subject that we have not written anything about the Panama Canal. But amenities having been exchanged between two of our contemporaries, this fact in itself is a sufficient excuse. The action of the Senate on June 21 appears to have settled the matter in favor of a lock canal which is believed to be the best. We have no doubt the canal could be built either way, although a difficult and uncertain problem confronts the advocates of the sea-level plan. The control of the Changres river is the greatest difficulty in the way of building a sea-level canal and the construction and stability of the dam at Gatun is the serious problem of the plan that has been adopted. The sea-level plan had apparently been abandoned when the San Francisco earthquake occurred; fear for the safety of the high-level canal probably induced the Senate to revive the other plan and perhaps give undue weight to the assumed danger from earthquakes. The Isthmus is a pretty substantially built country underneath, and no earthquakes have shaken it seriously for centuries; besides it is likely that the proposed dam to control the Changres would be in just as much danger as the locks and dam at Gatun. So we believe the public may rest assured that a lock canal will be built, in accordance with the views of a majority of American engineers. As a matter of sanitation, however, there can be no question whatever that a sea-level canal possesses advantages that a lock canal does not. The complete and constant flow of a stream of sea water—nature's own disinfectant—would have been a Godsend to the many miles of surrounding marsh and the many thousands of people who will, perforce by gravitation, eventually occupy the territory. In any case the success of the Suez and Manchester ship canals are object lessons worthy of emulation. The appointment of John W. Ripley, general superintendent of the Sault Ste. Marie (Mich.) locks, is an assurance that Chief Engineer Stevens proposes to avail himself of the best knowledge and skill obtainable.

Much Money to Be Saved

FOR many months the Committee on Water Supply of the Merchants' Association of New York City has had the subject of Waste and Leakage of Water and Its Prevention under consideration. It retained the services of James H. Fuertes, C.E., who has made an exhaustive study of the subject of the waste of water and its reduction by meters. Mr. Fuertes has brought together a very large body of data bearing upon this subject, in which is embodied the experience of practically all American and most of the principal European cities in which meters have been installed, and has traced the very valuable results which have been achieved. Mr. Fuertes's examination demonstrates that if meters be placed at the public expense upon all the service pipes in the City of New York a net saving of from $20,000,000 to $30,000,000 will be effected by postponing the date at which a second extension of the water system will become necessary. Mr. Fuertes's Report, together with a digest of the laws relating to metering in the City of New York, and a summary of present conditions affecting the city's water supply, is in course of printing. It will be distributed to members shortly. The committee also drafted and secured the passage of a law permitting the Commissioner of Water Supply, Gas and Electricity to place a large number of experimental meters in this city, at the public expense, for the purpose of accurately determining the consumption of water by various classes. The purpose is to afford sound data upon which to revise the existing system of water charges and substitute equitable meter rates which shall not unduly restrict the domestic consumption of water nor bear oppressively upon domestic users.

Train-shed Roofs

THE announcement that the train-shed roof of the new Pennsylvania terminal in New York City will be a lofty structure will be received with gratitude by the traveling public who have recently been reconciling themselves to discomfort and inconvenience. Since the fall of a part of the roof of the Charing Cross Station, London, some six months ago—an incident preceded by sundry inopportune fallings of glass—plausible arguments have not been wanting for the abandonment of this expensive type of structure. It was said, and truly, that minute quantities of sulphuric acid, emitted with soot from engine stacks, would corrode the steel and render the life of the roof far shorter than had been supposed. Apparently in accordance with this idea, it was reported that the new stations in Washington and Hoboken, N. J., would be provided only with umbrella platforms along the tracks. This plan has evidently been modified in the case of the Lackawanna terminal, as a low moderate span roof of reinforced concrete with no steel exposed to corrosion is now being built. In this instance the roof is supported by cast iron pillars in the center of the walks between the tracks. Over the center of each track a narrow opening is left for the escape of steam and smoke. In fact, everything possible will be done in every way to conform to modern, up-to-date ideas.

THE DISPOSAL OF MUNICIPAL WASTE

Systems and Methods, with Special Reference to American Conditions—Cleveland, Ohio, City Plant—Various Reduction Companies—Analysis and Comparative Values of Waste—Early History

By WILLIAM F. MORSE, Sanitary Engineer, New York

This Series of articles begun in the February number, will be continued until completed and will be illustrated by original drawings, cuts, diagrams and pictures, and contain many tables valuable for reference.

The Subjects Already Treated by the Author Are:

1. The Waste Collection Service in American Towns; Methods and Results.
2. Definition of Terms; Quantities; Proportions; Character of Waste in General.
3. Garbage; Analysis; Proportions; Values.
4. Dry Refuse and Rubbish; Quantities and Treatment.
5. Classification:—Commercial Values after Recovery.
6. The Refuse Utilization Stations in New York, Boston, Buffalo, and Brooklyn (illustrated).
7. Municipal Ashes; Analysis; Proportions; Values when Separated.
8. Ashes from Cremation of Garbage; Analysis and Values; Comparative Table.
9. Comparison of Ashes from English and American Cities; Cremation Means.
10. The Utilization of Municipal Waste in General; English and American Methods.
11. Commercial Values of Refuse and Ashes when Marketed and Manufactured.
12. The Analysis of Garbage; Tankage, Its Value (Special Tables).
13. The Garbage Disposal Plant, Cleveland, Ohio.
14. Street Sweepings; Fertilizing Value and Treatment.
15. Comparative Commercial Values of Waste.

The Following Are to Appear:

16. Methods of Disposal; Cremation.
17. Beginning and Progress.
18. Apparatus and Furnaces; Record of Work (Illustrated).
19. Apparatus and Furnaces; Record of Work; Results.
20. Types of Furnaces; Their Employment; Municipal, Institutional, Industrial, Medical, Laboratory (fully illustrated).
21. Calorific Value of Waste as Fuel (comparative table).
22. Reduction and Extraction Process Described and Illustrated; the Earlier and Later Methods.
23. Foreign Destructors; Special Chapter by an Eminent Authority.
24. American Methods; Col. Waring and His Successors.
25. Present Situation in This Country; Résumé.
26. Means for Improvement as Suggested by Several Investigators.
27. What May Be Expected of the Future.

THE comparatively slow adoption of tankage as a fertilizing material is not due to ignorance on the part of the manufacturers of fertilizers in the United States. Its character and value are well known, and to a limited extent it has a purpose which it admirably fulfills but certain disadvantages confine its sale to a few manufacturers who are equipped to use it. The price of garbage tankage depends upon the analysis of the constituents, as before stated, and these upon the presence of nitrogen. The quotations are from $5 to $9 per ton, averaging $6 for the strictly garbage product.

Since the various processes for reduction by these means are the property of private companies, and are supposed to be held under patents, it is difficult to procure accurate data. There is, however, one exception to this rule which furnishes some information of interest.

REPORT OF THE CITY GARBAGE DISPOSAL PLANT, CLEVELAND, OHIO

THE city of Cleveland in 1905 bought the plant of the *Newburg Reduction Company,* which was of the Chamberlain process of extraction of grease by means of hydraulic presses. During the year 1905 the city also purchased a complete new plant of the *Edson process,* which only went into operation in 1906.

Cleveland — Construction, Expenses and Income for 1905:

Cost of old plant, machinery and equipment		$33,052.06
Cost of land, buildings and additions, new plant		37,443.31
		$70,495.37
Less depreciation on old equipment		3,154.45
Total cost of plant		$67,340.92
Income—sale of products for year, etc		$65,881.14
Expenses—cost of operating	$54,449.38	
Extras and depreciation, 10 per cent.	3,744.33	58,193.71
Net profit for year		$ 7,687.43

Or 11.4 per cent. on cost of plant.

The report of Director of Public Safety for the year shows a recovery by the old process of 2.63 per cent. of grease and about 6 per cent. of tankage. They expect to recover during 1906 by the new process 3.75 per cent. of grease and 18 per cent. of tankage. For the first three months of this year the figures are 4 per cent. of grease and 21 per cent. of tankage. The capacity of these works is about 100 tons daily, collected and transported eight miles at the rate of $2.16 per ton. The cost of disposal was $1.80 per ton, making a total cost of $3.96 per ton for collection, transportation and disposal.

As compared with the expenses of collection and disposal for the year 1904, this shows a saving of $3,000, with 25 per cent. more service performed and $8,000 added to the value of the property.

The income from sale of by-products was $65,881.14, equal to $2.17 per ton of raw garbage treated, leaving a net gain of 37 cents per ton over the cost of reduction. A better showing will be made this year, as the repair bills will not be so heavy. The plant was in a run-down condition when the city purchased it from the contractor, and needed considerable repair and replacing of machinery, all of which was figured in the operating expenses.

ANALYSIS OF TANKAGE, APRIL 20, 1906

Ammonia	4.20 per cent.
Bone phosphate of lime	6.55 " "
Potash	1.26 " "

OTHER REDUCTION COMPANIES

There is another company, operating under the name of the Sanitary Reduction and Construction Company of Boston, Mass., which uses the "Weiselogel" process. This company has one small plant at Vincennes, Ind., and an experimental digestor at work in Jacksonville, Fla. No data are obtainable, although their published letters claim

a great advance over any reduction process that has yet been presented. They offered to install for one Southern city a 100-ton plant for $45,000, at a late competition, but were not successful in obtaining the contract.

The only other reduction process not mentioned is the "Chamberlain," in use at Detroit and Cincinnati, from which no analyses of samples or other data can be had.

Street Sweepings—Quantities and Values

Street sweepings is the last constituent of municipal waste to be considered, and although usually not a part of waste disposal work, still is an item of the whole mass of waste from which some returns may be expected.

In 1898 the general government collected data in regard to sweepings, from which the following is quoted:*

"Of 354 cities to which inquiries were sent, 150 made no report, and of the 204 reporting, 70 had no method of utilization; 74 used them (street sweepings) for filling land, and 60 cities, or about 17 per cent. of the whole number, with a population of 10,000 to 100,000, used them for fertilization. For the cities reporting, the average quantity collected was 168.9 tons for 1,000 population. Assuming this to be a true average, then, for all the cities of the United States the total amount would be three million tons."

The Fertilizing Value of Sweepings

The value of sweepings for land dressing depends greatly upon the nature of the paving from which they are taken. It is practically nothing when it comes from macadamized roads, and only approaches good stable manure from the well-kept, hand-swept streets of crowded cities. Sweepings are often mixed with much foreign matter, which lowers their value. There are few reports of the value of sweepings available. These are presented in the table above.

Street sweepings when dried average 50 per cent. of sand, powdered stone, abraded iron and other foreign matter, and 50 per cent. of combustible organic matter. During continued fine weather the sweepings become finely divided and pulverized, and when taken up by the wind are a nuisance to the public and a positive injury to property. It is claimed that disease germs are communicated in this manner, and it is reported by physicians in the larger cities that the increase in catarrhal and kindred diseases during periods of dry, windy weather are noticeably above the normal percentage.

In 1905 New York City separately collected the street sweepings and delivered them in bags at the dumps to the Long Island Railroad, which sent them to the farmers, charging only the cost of freight and handling. This experiment was not satisfactory, as the cost of the bags, which quickly rotted, and the freight charges, were more than the value of the material. There being no storage facilities, no disposal could be made in winter, and the attempt to utilize sweepings in this way was abandoned. They are now sent with ashes to fill land on Riker's Island. Though the approximate value of this waste is about $1 a ton, only under exceptional conditions of cheap transportation can it be made to return a revenue. Stable manure is now removed in New York by a company, for the payment of about $1 per load, and is sent by carload to deposits in the country for delivery to farmers. Some large express companies burn their manure, mixed with coal, under steam boilers, with the aid of forced draft.

The government reports from farmers using sweepings are to the effect that their value is about two-thirds that of farmyard manure, giving best results when used as top dressing. The cost varies from 15 cents to $2 per ton, to $6 per carload. They contain a considerable amount of stones, cans, etc., that must be removed by the purchaser, and they should be well rotted before using.

Table XXV. Analysis of Street Sweepings and Manure

	Moisture	Ash	Organic Matter	Nitrogen	Phos. Acid	Potash	Magnesia	Lime	Per Ton of 2,000 Lbs. Nitrogen	Phos. Acid	Potash	Value per Ton
	%	%	%	%	%	%	%	%	lbs.	lbs.	lbs.	$
Washington, D. C.:												
Average of 18 samples Street Sweepings.	31.6	48.7	19.3	.44	.07	.19	....	....	8.8	1.14	3.8	1.06
Trenton, N. J.:												
New Jersey Exper. Sta'n Street Sweep'gs.	....	....	....	.18	.30	.19	....	....	3	6	3	.90
New York City (Craven):												
Street Sweepings	37.28	32.	30.72	.25	.35	....	....	....	5	7	7	1.00
Berlin (Vogel):												
Exper. Station Street Sweepings	39.80	37.67	22.44	.47	.45	.37	.34	1.8	9	9	7	1.50
Hatch Experimental Station, Mass.:												
Horse Manure	11.24	....	....	.74	1.45	2.82	....	....	15	29	56	4.91
The same:												
Barn-yard Manure	67.01	....	....	.52	.39	.52	.30	.19	10	7	11	1.65

General Summary of Waste Utilization Methods

In this table are brought together the items of waste separately analyzed and classified in the previous tables, and it represents the theoretical commercial values which, although undoubtedly present in the waste, are in such combination with one another as to make it impossible to utilize them when collected in a mixed mass. But when separated into their classes at the houses there is no difficulty in providing treatment for the recovery of the commercially valuable of each class. This is done now by the separation of garbage for reduction, by the separation of refuse for market, and by the use of a part of the ashes for concrete work and brick making. It is necessary only to carry this one step further and in providing

*The fertilizing value of street sweepings, U. S. Agricultural Bulletin No. 55, H. W. Wiley and E. E. Ewell, Chemists.

TABLE XXVI. COMPARATIVE APPROXIMATE VALUES OF MUNICIPAL WASTE

One Ton Each of—							
Garbage	Reduced to Ashes	$0.55	As a Raw Fertilizer	$1.91	Treated by Reduction Process	$3.71
Refuse	Sorted parts only	2.45		2.45		2.45
Ashes	Coal, clinker, fine ash	1.62		1.62		1.62
Street Sweepings	For Fertilizer	1.00		1.00		1.00
Totals		$5.62		$6.98		$8.78

for waste disposal add the equipment required by each class of material and deal with all the waste, instead of dividing it up among several opposing methods or among several different contractors.

A return will always be available from the waste when it is properly treated by the best means. Coal will never be cheaper than it is now, and a partial supply from whatever source, even if of a poor quality, will always command a market. Clinkers and ashes have just been discovered to be of real worth, and we have only to note the many uses to which these unpromising materials are put abroad to see what may be done with the same things here. Paper stock is cash on demand, and nearly everything of a fibrous nature can be manufactured into one or another form of paper. The return to the earth of the waste of households in the form of fertilizers, of garbage concentrated into ash by fire or into tankage by chemical processes, is an economical means of dealing with large volumes of matter which returns a revenue, or profit, over all expenses.

Bringing all the waste to one station and using each method best adapted to each material means economy in equipment and operation, as the residuum from one class of refuse will furnish power and heat for the treatment of the whole.

Now that the real value of certain parts of discarded matter are better known and have a recognized standing in the world's markets, there may be expected a movement, which is indeed already begun, that will give the benefit of the economical treatment of waste products to the people, who are the ones chiefly concerned, and who should chiefly benefit by the wisely administered, economical and sanitary methods at the service of municipal authorities.

EXAMPLES OF THE UTILIZATION OF WASTE MATERIALS

Frequent reference has been made by many writers to the methods and appliances used abroad for the recovery of some useful by-product of the disposal of waste, and many valuable hints are to be had from the records of towns that have had longer experience in this line than most of our American cities.

We have little to learn from the examples of Continental cities, except that some of their methods of careful collection and systematic service might well be adopted, but in Great Britain there are many ways of dealing with waste matter, born of the pressing necessity for economy and efficiency, that may well apply to our own needs. The quotation given at the beginning of this article concerning the insanitary method of sorting general refuse applies to the conditions of twenty years ago, when they were beginning the serious study of the question. Great advances have been made since those days by the use of mechanical devices for conveying, separating and utilizing the various parts of the town's refuse. All these are made possible by the use of steam power generated by the waste itself, and this steam power is the principal factor in the various methods and forms of utilization. But, aside from the value of the power developed in the larger English cities by the employment of powerful refuse destructors, and which is used for municipal lighting, traction, water and sewage pumping, etc., is the great field for the manufacture of certain forms of building material made from the clinker and ashes left after the destruction of the combustible part of the waste.

We have practically the same kind of waste to deal with, and one that contains a far larger proportion of valuable matters than that of any foreign community. The American people enjoy a plentiful supply of food, clothing and fuel easily and cheaply obtained, and are more wasteful in their habits of life than any other nation. The absence of economy in the disposal of all residue excites the wonder and astonishment of foreign observers. This habit of wastefulness, probably caused by exceptional abundance, is a national trait that cannot and need not be changed, but there is every opportunity to profit by the example of others who have advanced the art of economic waste disposal by a quarter of a century.

DISPOSAL OF MIXED WASTE

There is but one opinion as to the means of sanitary disposal of municipal waste when it is collected in an unseparated mixed condition by the city's cart—it should be destroyed by fire. The mass contains every class of waste intimately mingled by gathering from every source alternate layers of garbage, ashes, refuse, trade waste, street sweepings, leaves and park refuse, and sometimes manure also. The ashes of this mass furnish a temporary relief from the odors as the liquids are absorbed and the particles of animal and vegetable matter become coated with the fine ash, which arrests putrefaction for a short time.

When these loads of mixed wastes are discharged at the dumps, in order to save the expense of covering and to avoid the nuisance of flying papers, frequently the refuse is set on fire and may burn for days, sending out clouds of nauseating smoke. The suburbs of most towns, where there are no means of disposal except by dumping, are nearly always subjected to this nuisance. In one New England city the dump fire, after burning for days, was so offensive that the Fire Department was called in for the relief of adjoining householders.

For the larger towns where separation is made there is less difficulty in disposal, for each class can be treated by itself, but for the smaller places where a mixed collection by private or contract service is made, the final disposition is the hardest problem that the town has to solve.

The crematory system in this country was at first designed only for garbage, animals and night soil, the refuse and ashes collected together being left for other means of disposal. Later, larger crematories, which would also destroy the refuse, were designed, and the prevailing American practice now is to specify larger structures at greater cost, that will provide for everything except ashes, and by using the refuse as fuel to lessen the cost of operating.

The value of refuse as fuel when collected with garbage is not so great as when separation is made, for the combustibles do not burn rapidly when saturated with moisture and, under the slow conditions of natural draft, require additional fuel. When the refuse is separated, the combustion is more rapid, but still has not sufficient calorific power to destroy the garbage unless there is a larger proportionate supply of refuse than is usually found in municipal collections.

When ashes are added to the collection the difficulties are increased beyond the ability of the furnace to deal with, and, recognizing this, the custom of American builders is to stipulate only for the disposal of garbage and refuse, sometimes adding a small proportion of night soil and animals, but omitting ashes and street sweepings.

The Present Situation

This, then, is the present situation in this country. The towns and cities having any means for waste disposal—other than the primitive methods of dumping or feeding to swine—employ the systems of reduction, or extraction, and cremation, or incineration.

Of the reduction methods there are three forms differing slightly in their manner of employing steam or naphtha as a solvent, and in their forms of apparatus.

The larger cities adopt this reduction method, though in several it is also combined with other means.

The smaller towns use cremation, or incineration The form of crematory construction follows mainly the type at first employed—a long rectangular chamber, fed through charging holes in the roof, the garbage being received on transverse horizontal grates of iron or fire brick. The fire boxes are placed at the front end of the furnace with a secondary fire grate at some point within the furnace or between the furnace and the chimney. This type has been designated as the American form of crematory, as distinguished from the English form, of cell construction with a drying hearth immediately adjoining the fire grates, and without the secondary fire, but employing forced draft under the fire bars for obtaining high temperature.

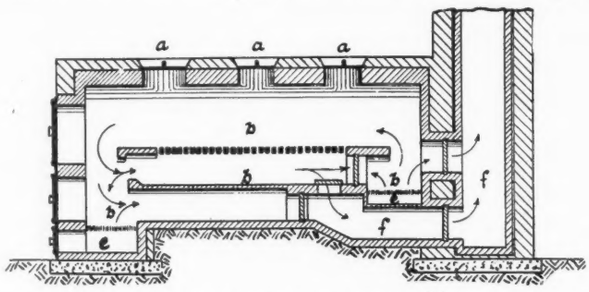
There are two exceptions to this form of furnace—with three examples only—of a type following the cell construction, but as they employ natural chimney draft, and consequently do not attain the highest temperatures, these may also be classed among the American crematories.

Summary of American Crematory Conditions

A comprehensive statement of the present conditions under which American garbage furnaces are now operating may be thus made:

1.—All of these furnaces are designated as cremators, crematories, or incinerators, following the descriptive titles used by their builders.

2.—Those that have survived preliminary stages and can show a record of three or four years of successful use, follow the same general type of construction and interior arrangements, with minor differences of exterior walls of brick or steel plate, but with the same charging



ENGLE CREMATOR—EARLY FORM, 1887

and stoking methods, and practically the same necessity for a secondary fire for destroying odors.

3.—They contract for the disposal of garbage mixed with light refuse, and may include animals and a small amount of night-soil, but they do not contract for the disposal of ashes or street sweepings.

All, without exception, require additional fuel for completely successful combustion.

4.—In no case is there a boiler plant attached where a guarantee of power can be made based upon the disposal of the waste.

5.—The two exceptions to this general form follow the cell construction: burn the same mixed garbage and refuse, but do not use forced draft; nor can they develop power for any general service.

The foregoing applies to those examples of American crematories that have survived the preliminary stages of trial and have a sufficient number in use in different sections of this country to show their adaptability to all conditions of climate and local surroundings.

Though there have been upward of 225 patents issued in the United States for various forms of garbage and refuse furnaces, and over one hundred and twenty-five different furnaces built for municipal disposal work, at this time the number actually operating will not exceed sixty-five to seventy, with seven others under construction. It appears that the number discontinued yearly very nearly keeps pace with the number built.

Up to this time it has been the writer's purpose to bring together the available preliminary information on the general question of waste disposal and to tabulate this for service. It is now the intention to describe the various apparatuses and their work, and it seems desirable to begin with the description of the work done abroad, where this subject has been more thoroughly investigated and where the results are more completely recorded.

The next articles will deal with the waste disposal work of other countries as described and illustrated by Mr. W. Francis Goodrich, A.I.Mech.E., F.I.S.E., Great Britain.

(To be continued.)

Brevities

AKRON, OHIO, claims the distinction of having the first automobile patrol wagon in the country. It is said to be only one-third as expensive to operate as would be a patrol wagon drawn by horses, and the Board of Public Service is considering the advisability of installing automobile fire apparatus.

BUNKIE, LA., Council proposes to establish a water system, and to that end has called an election to vote a bond issue.

CLEVELAND, OHIO, Board of Public Safety has adopted the police signal system recently invented by Capt. Jerry Murphy. It will be installed at a cost of $40,000.

DETROIT, MICH., Aldermen are considering an ordinance, presented by the Municipal League, creating the City Comptroller, the City Treasurer and the President of the Council a commission to make the appointments and control the work of the janitors, engineers, elevator men and others under a civil service plan.

FORT WORTH, TEX., Council, at a heated sesson recently, voted down Mayor Harris' recommendation to advertise for bids for the sale of the street sprinkling wagons and to advertise for bids for the street sprinkling.

FREEPORT (L. I.), N. Y., is to organize a fire company.

HARTFORD, CONN., will have public golf links, the Park Board having instructed Superintendent Packer to lay out a course at Goodwin Park.

HOUSTON, TEX., recently has made her début in the ranks of municipal ownership cities, having purchased the plant of the Houston Water Company for $901,000. The commission promises pure water always and an abundance of it, the installation of meters, and the extension of water mains over the entire city.

KANSAS CITY, MO., Council, on recommendation of Mayor Beardsley, is considering the establishment of a municipal asphalt plant. An ordinance providing for a second assistant City Engineer to make chemical tests of asphalt has passed the upper house.

LEXINGTON, KY., is to shortly begin operating a crematory and garbage incinerator, the finishing touches to the $15,000 plant being now put on by J. H. Tudor, the contractor and builder.

LOS ANGELES, CAL., by a bill unanimously passed by the National House of Representatives, is granted a right of way over public lands for water conduits.

LYNN, MASS., Board of Public Works has ordered $100,000 in sidewalks that have not been built, not including orders passed by the City Council this year. No new work will be ordered this year, and Mayor Barney is hopeful of securing an additional sum for sidewalks after the current appropriation of $10,000 is expended.

MONROE S. D., citizens are planning to establish fire protection.

NEW BRITAIN, CONN., Council Committee, consisting of Messrs. Hipp, Schaefer and Ahearn, is on record as favoring a municipal ice plant, and will secure estimates for building a storehouse on Shuttle Meadow Lake.

NEW ORLEANS, LA., has recently experienced a shortage in its water supply; the water company has been pumping 12,000,000 gallons daily more than its normal output, and at a pressure of 96 pounds, the maximum capacity of its plant; and Mayor Behrman has written the Commissioner of Public Works, calling attention to the need of retrenchment for commercial and sanitary purposes and to avoid risk in case of fire.

NILES, OHIO, Council has passed a curfew ordinance inflicting a penalty on parents or guardians whose children under 14 years of age are found on the streets after 8 o'clock at night.

NORFOLK, VA., Council committee has reported in favor of a magnificent boulevard to the Jamestown Exposition, and Chairman Hatch will confer with Commonwealth's Attorney Marshall and the County Board of Supervisors as to funds and the route.

NORRISTON, PA., municipal electric plant cost $12,800, or $59.51 per arc lamp, the past year.

PHILADELPHIA, PA., officials plan to extend the high-pressure water main system to the principal business sections of the city at an outlay of $2,000,000. It cost $1,000,000 to install the system in the district bounded by Race, Walnut and Broad streets and Delaware avenue.

PUEBLO, COL., citizens recently celebrated the breaking of ground for paving streets in the South Union aveune paving district with ceremonies in which Mayor John T. West, City Engineer A. E. Mackintosh and the members of the City Council participated.

READING, PA., has been compelled to assume charge of its own street cleaning work, on account of blunders of Council and the Board of Public Works in making a new contract. City Engineer Elmer H. Beard is having the work done under supervision of the employes of the Highway Department.

Some Unusual Fires

BAYONNE, N. J.—A moving fire—a furniture van caught fire and the horses ran away. Fire engines followed for several blocks before the fire was extinguished.

CHICAGO, ILL.—Mabbatt elevators with 100,000 bushels of grain and adjacent buildings burned June 23. Cause, spontaneous combustion in dust room. Amount of damage, $250,000.

GOLCONDA, ILL.—City lighting plant and two business blocks burned June 23. Fire originated in a laundry. Amount of damage, $100,000.

NICOLET, QUEBEC.—Roman Catholic Cathedral, one of the finest in the Province, burned June 21. Cause unknown. Amount of damage, $500,000.

POLLOCK, LA.—Big Creek Lumber Co., railroad trestle, 49 cars, 18 houses and one hotel burned June 18; 1,000 men out of employment. Cause unknown. Amount of damage, $300,000.

SANTA CRUZ, CAL.—The Casino, pavilion and other buildings on water front were burned June 22. Fire originated in grill room, uncontrolled on account of failure of water supply. Amount of damage, $300,000.

Utilities, Trade Notes and News

PIPE COUPLINGS.—S. R. Dresser, Bradford, Pa., issues a catalogue describing his line of pepe couplings, clamps, sleeves and fittings for wrought and cast-iron pipes; also oil and gas well packers, casing heads, wall fasteners and rubber plugs. Within the past year he has added 1,600 square feet of floor space to his factory and is prepared to supply high grade goods demanded by a growing business. Dresser insulating couplings are designed to protect pipes from electrolytic action.

WATER METERS.—The Thomson Meter Company, 79 Washington street, Brooklyn, N. Y., manufactures the Lambert Meter, in all sizes from 5/8 to 6-inch. The Lambert is a disc meter in which the disc is reinforced with an internal steel plate to prevent breakage; the best bronze composition is used throughout; all parts align to a common center; they can be taken apart and reassembled easily. The displacement per oscillation of disc is large.

WATER METERS.—The Neptune Meter Co., 120 Liberty street, New York City, publish a catalogue of their goods which is a fine example of the printers and engravers' art, as well as a clear exposition of the details of their Trident meters. The meter has but one working part, a simple disc piston suspended in the center by a ball and socket engagement. The operation of the piston, in connection with the diaphragm, divides the measuring chamber into four distinct compartments, which are alternately filled and discharged. The bottom of the meter is designed to resist breakage from freezing. The Trident Crest is a meter of the velocity or inferential type, made for heavy duty in connection with primary mains, railroad standpipes, hydraulic elevators and the like.

WATER PURIFICATION AND FILTRATION.—The New York Continental Jewel Filtration Co., 15 Broad street, New York City, issue a catalogue describing their filters and some of the plants in which they have been installed. Their factories are claimed to be the largest in the world devoted exclusively to the manufacture of filters. They have taken out 400 patents and have had their system adopted by over two hundred towns and cities. Both pressure and gravity filters of widely varying capacities are made.

WATER SUPPLY. PURIFICATION. — Messrs. Bull & Roberts, Chemists, 100 Maiden Lane, New York City, have applied the copper sulphate treatment to three reservoirs of 11,000,000 gallons capacity at Middletown, N. Y. The treatment has extended over a period of two years and has been effective in removing algae.

WELL DRILLING.—The Artesian Well and Supply Co., Providence, R. I., issue a list of wells drilled by them during the past season. The list affords an interesting study of the capacity of different size wells in the various localities in which they worked. The depth of the well is not given. A 6-inch well at Douglasston, N. Y., delivers 290,000 gallons per day, while an 8-inch well at North Eastern, Me., develops 5,000 gallons.

AMERICAN WATERWORKS ASSOCIATION CONVENTION

Twenty-sixth Annual Session, Boston, Mass., July 10-14, 1906

Programme

Monday

Secretary's Office, Rogers Building, Massachusetts Institute of Technology, Boston, Mass., open at 9 o'clock, A. M. for Registration of Delegates and other business.

3 o'Clock P. M.—Meeting of Executive Committee.

5 o'Clock P. M.—Meeting of Finance Committee.

Register at the Secretary's Office; get your Convention Badges and Tickets for Entertainments.

Lists of those registered will be published during the Convention, as a means of identification.

Tuesday

10 A. M.—Reception and Welcome by Local Committee, through the Governor, Mayor, Presidents of the Massachusetts Institute of Technology, the New England Water Works Association, and Boston Society of Civil Engineers.

Election of Members; President's Address.

Reports

Executive Committee. Secretary-Treasurer. Finance Committee. Standing and Special Committees.

1.30 P. M.—Notes on Sewage Disposal and Public Water Supplies, M. N. Baker
River Pollution.....M. O. Leighton
The Greatest Typhoid Epidemics.....Dr. Geo. A. Soper
Filtration of Water, the Element We Have to Deal With.....F. A. W. Davis

8 P. M—Extension and Improvement of the Supply Main, Yarmouth, N. S.....Geo. H. Robertson
Water Softening for Municipal Plants (Illustrated by lantern slides).....Geo. W. Fuller
A Pictorial Appeal, Water-Works, Too (Illustrated by lantern slides).....H. F. Dunham

Wednesday

9 A. M.—Election of Officers and selection of place for holding the next Annual Convention.

A Symposium of the Chicago Drainage Canal Case.....Prof. W. P. Mason
The Chicago Drainage Canal in the United States Courts.....Jno. W. Hill
Self-Purification of the Mississippi River During the Latter Part of its Course.....Robert Spurr Weston
Abstract of Testimony.....Prof. T. J. Burrill

Papers by

Prof. Gardner S. Williams, Prof. E. O. Jordan,
Prof. Adolph Gehrmann, Profs. H. L. Russell and E. O. Jordan.

Oral Discussion by

Rudolph Hering, Geo. W. Fuller, Allen Hazen
Geo. C. Whipple, Prof. Erastus G. Smith,
Prof. Leonard C. Kinnicutt, Isham Randolph, and others.

1.30 P. M.—Same Subject Continued.

Evening.—A trip to "Wonderland."

Thursday

9 A. M.—Copper Sulphate Results.....James M. Caird
Disinfection as a Means of Water Purification.....Geo. C. Whipple
Boiler Plant Economy.....Prof. C. H. Hurd
Notes on Comparative Efficiency of Cast-Iron and Riveted Pipe L. J. LeConte

1.30 P. M.—Trip Down the Harbor, Buffet Lunch.

Evening.—Theatre Party, or "Stag Entertainment," as members choose.

Friday

9 A. M.—Expanding Water Supply Systems.....J. T. Fanning
The Growth of the Pumping Station.....Chas. A. Hague
Pump Slippage.....Alba L. Holmes
The Simplex Water Meter.....J. W. Ledoux
A New Hydraulic Unit.....Danl. W. Mead

1.30 P. M.—For the ladies, a drive to the Country Club, with lunch there. (Start at 12.30. Lunch at 2 o'clock.)

A Retrospect of an Arbitration on the Value of a Waterworks Albert H. Wehr
Some Interesting Facts Regarding the Great Earthquake of April 18, 1906.....L. J. LeConte
Protection of Meter Register.....C. E. Loetzer
Volunteer Papers. Question Box. Experience Meeting.

8 P. M.—Philadelphia High-Pressure Waterworks.....F. L. Hand
Cheesman Dam (Illustrated with lantern slides).....George T. Prince
Description of The Metropolitan Waterworks (Illustrated with lantern slides).....Dexter Bracket

Saturday

Trip to Wachusett Dam or to Lexington, as members choose. Buffet Lunch. Starting 10 A. M., Returning 5 P. M.

Standing and Special Committees

Publication

H. E. Keeler, Chairman, D. W. Mead, John W. Alvord, Dabney H. Maury, J. M. Diven.

Electrolysis

Dabney H. Maury, Chairman, G. H. Benzenberg, J. Waldo Smith.

Water-Works Standard.

Charles A. Hague, Chairman, G. H. Benzenberg, John C. Trautwine, Stephen E. Babcock, William R. Hill, Theodore A. Leisen.

Fire Protection

C. H. Campbell, Chairman, F. W. Shepperd, George H. Felix, M. R. Sherrard, A. E. Boardman, Charles A. Hague, Robert J. Thomas.

Uniform Annual Reports

Dow R. Gwin, Chairman, John Caulfield, Jerry O'Shaughnessy, Chas. E. Rowe, O. Elwood, Philip F. Ryder.

Exhibits

James H. Caldwell, Chairman, T. J. Nagle, Thomas Dwyer, D. F. O'Brien, William Ross.

Entertainment

J. A. Tilden, Chairman, A. S. Otis, Oscar Mueller, Charles H. Baldwin, Robert J. Thomas, Geo. T. Coppins.

ADVANCE AND WEEKLY CONTRACT NEWS

Relating to Municipal and Public Work—Street Improvements—Paving, Road Making, Cleaning and Sprinkling—Sewerage, Water Supply and Public Lighting—Fire Equipment and Supplies—Buildings, Bridges and Street Railways—Sanitation, Garbage and Waste Disposal—Police, Parks and Miscellaneous—Proposals and Awards

The Municipal Journal and Engineer wishes to obtain, at the earliest possible moment, advance and reliable information respecting all work projected. Any items sent us will be greatly appreciated. On request, copies containing such information will be mailed to you.

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All items arranged alphabetically by States.

STREET IMPROVEMENTS

Oakland, Cal.—It is probable that parts of Webster and 13th streets will be paved.

Richmond, Ind.—It is recommended by Councilman Egbert that Eighth street be paved.—Mayor Zimmerman.

Alliance, O.—Bids will be received, July 9, for $42,500 street improvement bonds.—Chas. O. Silver, City Auditor.

Batavia, O.—Bids will be received, July 16, for the purchase of $2,000 sidewalk bonds.—Clerk Clermont county.

Dayton, O.—Bids will be received, July 12, for $8,200 5 per cent. paving bonds.—Edward A. Phillips, City Auditor.

Delaware, O.—Bids will be received, July 16, for $28,500 street improvement bonds.—F. D. King, City Clerk.

Gilsonburg, O.—Bids will be received, July 2, for $8,988 Main street improvement bonds.—W. O. Dipman, Clerk.

Madisonville, O.—An election will be held, July 14, to decide the issuing of $5,000 sidewalk bonds.

Plain City, O.—Bids will be received, July 20, for $9,500 street improvement bonds.—Henry P. Baker, Clerk.

Portsmouth, O.—Ordinances have been introduced for paving John street.

Tamaqua, Pa.—An election will be held, July 11, to vote on the question of issuing $24,000 paving bonds.

Chippewa Falls, Wis. The proposition to macadamize Bay and Cedar streets is being considered; cost of work, $10,000.

PROPOSED WORK

Bloomington, Ill.—A resolution has been passed for paving West street with asphalt, at a cost of $44,000.—Elmer Folsom, City Engineer.

Chenoa, Ill.—An ordinance has been adopted providing a system of concrete walks, to cost $10,000.—E. L. Beach, Mayor.

Granite City, Ill.—Street improvements to cost $66,000 will be made.

Mattoon, Ill.—Bids will be received for laying 2,500 square yards of brick pavement on concrete foundation.—C. L. James, City Engineer.

Indianapolis, Ind.—Rosefelt avenue will be paved with brick, Woodlawn avenue with bituminous macadam, and Pennsylvania and Bird avenues with brick.

Logansport, Ind.—It is proposed to pave Broadway and Third street.

Donaldsonville, La.—Bids are advertised for paving Mississippi street and Railroad avenue, at a cost of $50,000.

Marlboro, Mass.—Main street will be paved at a cost of $20,000.

Athens, O.—Franklin avenue will be improved by grading, curbing and draining.

Batavia, O.—Council is considering the proposition to lay sidewalks in several streets.

Bellaire, O.—Monroe and Sandusky streets will be improved by paving, curbing and ballasting.

Cleveland, O.—Sweeney avenue will be curbed, drained and paved.

Dayton, O.—An ordinance to pave Germantown street and Tecumseh street has passed Council.—C. A. Snyder, Mayor.

Hamilton, O.—Bids will be advertised for several street paving contracts.

Newark, O.—An expenditure of $20,000 will be made to pave Main and High streets.

New London, O.—About $10,000 will be expended for street paving.

Norwalk, O.—A bond issue has been authorized for paving East Main street, Benedict avenue and Chestnut street, at a cost of $40,800.

Portsmouth, O.—The following streets will be paved: Campbell avenue, Grandview, Clay, John, Market and Fifth streets.

Steubenville, O.—Council has decided to pave Lincoln avenue and lay brick sidewalks.

Youngstown, O.—Bids will be received for paving Delason avenue.

Zanesville, O.—Linden avenue will be paved from Van Horne to Adair avenues.

Pittsburg, Pa.—Ordinances have been passed to pave Neville street and Center avenue.

Reading, Pa.—The Council has decided to pave Sixth and Court streets.

Sigourney, Pa.—Several streets will be paved with asphalt.—W. H. Hamilton, Mayor.

Washington, Pa.—Bids will be received for repaving Jefferson avenue from Hall to Hallan street.

Armour, S. D.—Concrete sidewalks will be laid.

Dallas, Tex.—Gaston avenue is to be paved with asphalt.—Curtis P. Smith, Mayor.

Seattle, Wash.—Denny Way will be widened to 90 feet and regraded.

CONTRACTS TO BE AWARDED

Fort Smith, Ark.—Bids will be received, July 18, for constructing brick pavement in District 5, comprising about 650,000 square yards of paving.—Harry E. Kelly, Chairman, Board of Improvement.

Peoria, Ill.—Bids were opened, July 2, for paving Jefferson avenue.

Yorkville, Ill.—Bids were opened, July 2, for paving 15,000 square feet with cement.—Geo. Ohse, Clerk.

St. Paul, Minn.—Bids were opened, July 2, for resurfacing E. Seventh street with asphalt.

Jersey City, N. J.—Bids were opened, July 2, for repairs to asphalt pavements.—Geo. T. Bouton, Clerk.

Greenville, O.—Bids will be received, July 11, for paving, curbing and draining N. Main street and Broadway.—Dwight Matchette, Clerk.

Mansfield, O.—Bids were opened, July 3, for grading and paving Boughton avenue.

Plain City, O.—Bids will be received, July 10, for paving West avenue and Gay street.

Toledo, O.—Bids were opened, July 3 for improving Surety avenue by grading and paving with vitrified stone, asphalt block or sheet asphalt.

CONTRACTS AWARDED

Pueblo, Col.—The contract for paving N. Union avenue has been awarded the Cleveland (O.) Trinidad Paving Co., at $31,364.

Hartford, Conn.—The contract for curbing Park Terrace has been awarded the Hartford Paving and Construction Company.

Sioux City, Ia.—The contract for paving has been awarded the Barber Asphalt Paving Company, at $1.97 per square yard.

Topeka, Kan.—The contract for paving 36,000 square yards on Kansas avenue has been awarded the Parker Washington Company, at $1.24 per square yard.

Brunswick, Me.—The contract for macadamizing Main street has been let to Richard D. Shanahan, Portland, at $7,346.

Detroit, Mich.—The contract for paving and repairing ten streets has been let to the Central Bitulithic Paving Company, at $48,000.

Joplin, Mo.—The contract for street paving has been awarded Brown & Dobson, at $1.82 per square yard.

Canton, O.—The contract for improving East Eighth street has been awarded Harry Corl, at $3,108.

Columbus, O.—N. B. Abbott has the contract for improving Guilford street, Phugh street and Alsop street.—Board of Public Service.

Columbus Grove, O.—The contract for street paving has been awarded A. J. Bogart & Company, at $46,000.

Dayton, O.—The following street paving contracts have been awarded: Pearl street, J. E. Conley & Co., $3,761.20; Alley west of Wilkinson street, W. J. Kernan, $1,545.74; South Brown street, Barber Asphalt Company, $10,705.90; Alley east of Horace street, W. J. Kernan, $1,683.10; Alley north of Third street, W. J. Kernan, $1,423.62.—Fred J. Cellarius, Civil Engineer.

Marion, O.—Sanitary sewers in St. James street and Plain avenue will be constructed by Hurstetter & Dawson.

Marion, O.—The contract for paving Columbia street has been awarded Hufstetter & Dawson, at $33,646.

Reading, Pa.—The street-cleaning contract has been let to Henry J. Stocker for a period of five years.

Bluefield, W. Va.—The contract for furnishing brick for street paving has been awarded Kelly Brothers, Portsmouth, O.

Huntington, W. Va.—The following contracts have been awarded. Paving Eighth street with Athens block, Harrison & Dean, $20,000; paving Sixteenth street, Carlisle brick, M. F. Leonard, $10,000; paving Fifth avenue with asphalt block and combined concrete, Harrison & Dean, $5,000; paving Eighth avenue, Spillman brick, Kyle & Ullom; Twentieth street, Kyle & Ullom, $15,000.

ROAD MAKING

Washington, D. C.—Military Road, between Rock creek and the Daniels road, will be resurfaced with trap macadam at a cost of $4,000.

Baltimore, Md.—Bids will be received, July 16, for improving part of the Baltimore and Washington highway.—W. W. Crosby, Chief Engineer.

Snow Hill, Md.—Bids will be received, July 3, for $25,000 4½ per cent., 37 year, road improvement bonds.

Camden, N. J.—An issue of $66,000 road improvement bonds has been decided upon. The following roads will be improved: King's Highway, Mt. Ephriam, Nicholson Road, Blackwoodtown, Pike, Laurel Spring Road and Gibbsboro Road.—County Board of Freeholders.

Camden, N. J.—Bids will be received, July 11, for macadamizing Blackwood Turnpike a distance of 2½ miles.—J. J. Albertson, Engineer.

Freehold, N. J.—Bids will be received, July 11, for building a part of the rFeehold and Colts' Neck macadam road.—John Guire, Director, Board of Freeholders.

Toms River, N. J.—Bids will be received, July 10, for building a gravel road in Berkeley Township.—Board of Chosen Freeholders.

Mt. Kisco, N. Y.—Bids will be received, July 10, for macadamizing and improving the road from Bedford station to Bedford, a distance of 4 miles; also a road to Cliff House.—Jos. E. Merriam, Town Clerk.

Bucyrus, O.—Bids will be received, July 13, for $19,000 road improvement bonds.—J. H. Brown, Clerk.

Celina, O.—Bids will be received, July 21, for $12,000 Mercer county pike bonds.—T. A. Weis, County Auditor.

Columbus, O.—Bids will be received, July 20, for $2,500 Maize Free Turnpike improvement bonds.—Herman Weber, Secretary, Board of Commissioners.

Delaware, O.—Bids will be received, July 16, for constructing two roads.—E. S. Mendenhall, County Surveyor.

East Liverpool, O.—Calcutta road will be improved; about $40,000 will be expended.

Liberty, O.—Bids will be received, July 12, for the purchase of forty road improvement bonds.—Frank Freese, Clerk.

Napoleon, O.—Bids were opened, June 19, for $63,000 road improvement bonds.

Abington, Pa.—Road improvements to cost $50,000 will be made.

SEWERAGE

Waukegan, Ill.—The estimated cost of the projected sewer is $108,212.75, and will drain about 70,000,000 square feet of land.—Mayor Bullock, J. H. Orvis and F. W. Buck, Commissioners.

Kokomo, Ind.—A sanitary sewer system is being considered.—D. P. Davis, President, Board of Public Works.

Bucyrus, O.—It is probable that a large sewer will be built from Holmes Township to the Sandusky river.—Mayor Valentine.

Ironton, O.—It is probable that sewers will be built in Walnut alley.—Geo. H. Davies, Clerk.

Perrysburg, O.—It is probable that a sewer system will be installed.—Wm. Charles, Clerk.

Dallas, Tex.—The construction of a sewage disposal plant is under consideration.—Curtis P. Smith, Mayor.

Virginia Beach, Va.—The Council is considering the issuing of $60,000 sewer, water and lighting bonds.

PROPOSED WORK

Emmetsburg, Ia.—A sewer system and plant will be constructed.—T. F. Shea, Mayor.

Lapeer, Mich.—It is proposed to improve the sewer system.—Alderman Carrigan, Chairman, Service Committee.

Zumbrota, Minn.—A sanitary sewer will be constructed.—E. F. Davis, Recorder.

Trenton, N. J.—Extensive improvements will be made in the sewer system.—Harry B. Salter, City Clerk.

Crystal Falls, O.—A sewer will be constructed in District 2, at a cost of $16,000.—John Tufts, Member, Board of Public Service.

Galion, O.—It is proposed to construct 19 sanitary sewers.

Ravenna, O.—The ordinance authorizing the Board of Public Service to purchase six acres of ground for a sewage disposal plant has passed its third reading.

Wellston, O.—Plans will be prepared for a sewer in New York avenue.

Willoughby, O.—A sewer system will be constructed.

Youngstown, O.—Bids are advertised for constructing the Federal street sewer and the Griffith street sewer.

Norman, Okla.—Plans have been prepared for a sewer system to cost $36,000.

Washington, Pa.—A sewerage disposal plant will be constructed.—R. W. Pratt, Columbus, O., Engineeer.

Armour, S. D.—A sewer system will be built.

CONTRACTS TO BE AWARDED

Fort Smith, Ark.—Bids will be received, July 18, for constructing storm and sanitary sewers in District 2.—Harry E. Kelley, Chairman, Board of Improvement.

Marianna, Ark.—Bids will be received, July 14, for constructing a sanitary sewer system in District 1.—Max. D. Miller, Chairman, Sewer Committee.

Hartford, Conn.—Bids will be received, July 5, for constructing a sewer in School street.—Charles E. Parker, Secretary, Board of Contract and Supply.

Thomasville, Ga.—Bids will be opened, July 2, for $25,000 4½ per cent. sewer bonds.—J. F. Pitman, Mayor.

Belvidere, Ill.—Bids will be received, July 12, for repairing drainage ditch No. 1 in Boone Township.—David Hutchinson, O. K. Nelson and G. R. Clarkson, Drainage Commissioners.

Chicago, Ill.—Bids will be received, July 6, for fourteen items of sewer laying.—Board of Local Improvements, City Hall.

Elkhart, Ind.—Bids will be opened, July 6, for constructing a vitrified pipe sewer in N. Main street, at an estimated cost of $17,000.

Muscatine, Ia.—Bids will be opened, July 2, for $21,000 6 per cent. County drainage bonds.—A. S. Lawrence, County Auditor.

Pipestone, Minn.—Bids will be received, July 13, for constructing sewers and parts of sewers.—S. W. Funk, City Recorder.

St. Paul, Minn.—Bids were opened, July 2, for constructing a sewer on Tenth street.

Schenectady, N. Y.—Bids will be received, July 17, for $150,000 4 per cent. sewer bonds. O. S. Luffman, Comptroller.

Cambridge, O.—Bids will be received, July 19, for extending the sanitary sewer system, including 20,000 feet of 4, 8, 10, 12 and 15-inch vitrified sewer pipe, nine tons of cast-iron pipe, 139 cubic yards of concrete, etc.—O. M. Hogue, City Engineer.

Chicago, O.—Bids will be received, July 17, for constructing a sewer, according to plans. Riggs & Sherman, Toledo, Engineers.

Dayton, O.—Bids will be received, July 12, for the purchase of $13,200 5 per cent. sewer bonds.—Edward Phillips, City Auditor.

Malta, O.—Bids will be received, July 12, for constructing a combined sanitary and storm water sewer.—Paul R. Murray, Engineer.

Painesville, O.—Bids will be opened, July 16, for constructing storm sewers.—O. W. Kile, Clerk, Board of Public Service.

Toledo, O.—Bids will be received, July 5, for constructing sewer 956, between Fredonia and Maher streets.—Reynold Voit, Secretary, Board of Public Service.

Two Rivers, Wis.—Bids will be received, July 10, for constructing a part of the sewer system.—Board of Public Works.

CONTRACTS AWARDED

Peabody, Mass.—The contract for sewer sections 3 and 4 has been awarded Geo. M. Byrne, at $28,000.

St. Paul, Minn.—The contract for the sewer in Summit avenue has been awarded Ryan & Johnson, at $1,647.

Dayton, O.—Sewer contracts have been awarded to the following: C. R. Statleman, Notre Dame avenue, $676.05; Wm. Hilt, Troy street, $2,514; M. O'Herron & Co., Home avenue, $3,175; Paul & Kershner, S. Broadway, $8,640; T. J. Backus Construction Company, Summit street, $908; Paul & Kirshner, N. Broadway, $15,950.06.—Fred J. Cellarius, Civil Engineer.

Toledo, O.—The contract for the drainage system between Hamilton and Tecumseh streets has been awarded Watters & Tansey, at $7,000.

WATER SUPPLY

Oakland, Cal.—The Contra Costa Water Company which supplies Alameda and Berkeley, has been sold to the Realty Syndicate for $11,000,000.—Frank C. Havens, Vice-President and General Manager Syndicate.

Canon City, Col.—Plans are under way to secure a public water supply.—Hiram Philips, St. Louis, Mo., Engineer.

Assumption, Ill.—Plans are under way to provide a water system.

Cairo, Ill.—The extension of water mains has been petitioned for.

Port Huron, Mich.—It is recommended by Henry Burton, Waterworks Superintendent, that an engine be purchased for the pumping station.

Brookhaven, Miss.—The city is considering improving the waterworks plant at a cost of $30,000.

Addison, N. Y.—Plans are under way to establish a water supply to be secured from Goodhue Lake.

Akron, O.—Surveys are being made for the State reservoirs to be built between Long Lake and State Mill, at a cost of $18,000.—J. A. Gehres, Surveyor.

Amherst, O.—The proposition to issue waterworks bonds is under consideration.

Hamilton, O.—It is recommended that $100,000 be expended for enlarging the waterworks plant.—S. M. Goodman, President, Board of Public Works.

Warren, O.—The construction of a water and light plant is under consideration.

Poteau, Okla.—It is probable that a waterworks plant will be installed.

Nashville, Tenn.—A waterworks and electric light plant may be constructed.

Yacolt, Wash.—Water will be supplied by piping it from a mountain stream.

LaCrosse, Wis.—Plans are under way to lay water mains.

PROPOSED WORK

Cartersville, Ga.—An issue of $15,000 bonds has been authorized for extending water and gas mains.

Waynesboro, Ga.—The citizens have voted to issue $60,000 bonds for water, light and sewer improvements.

Thebes, Ill.—It is proposed to establish a water system.

Clarion, Ia.—Bids will be received for extending the waterworks system.

Farragut, Ia.—It is proposed to issue $6,000 waterworks bonds.

Nashua, Ia.—An expenditure of $5,000 will be made for improving the plant of the Nashua Water Power Company.

Lowell, Mass.—The Water Department has asked bids for 30 tons of pipe.

Lynn, Mass.—It is proposed to improve the waterworks plant.—State Board of Health.

Battle Creek, Mich.—It is proposed to issue $500,000 waterworks bonds.

Bellaire, Mich.—A system of waterworks will be installed.

Corunna, Mich.—Water meters are to be installed.

Moorehead, Miss.—A waterworks system will be installed.—W. E. Stephen, Mayor.

Bland, Mo.—A waterworks system will be installed.

Randolph, Mo.—An expenditure of $6,000 will be made for a waterworks plant.

Lincoln, Neb.—A triple-expansion pump, 3,000,000 gallons capacity, will be installed.—Wm. Grant, City Engineer.

Scotia, N. Y.—It is proposed to extend the water mains.

New York, N. Y.—The plant of the Crystal Lake Water Supply Company, Staten Island, will be purchased at $730,000, subject to vote of Board of Estimate.

Washburn, N.D.—A waterworks system will be installed.

Crestline, O.—Bids will be advertised for $10,000, water and fire improvement bonds.—J. L. Lindsey, Clerk.

Findlay, O.—The waterworks system will be installed.

Wauseon, O.—An expenditure of $20,000 will be made to construct an addition to the waterworks pumping station.—Chas. J. Hodges, Clerk.

Madill, Okla.—Plans have been completed for the waterworks system.

Delaware Water Gap, Pa.—The Delaware Water Gap Company will furnish the water supply.

Pittsburg, Pa.—It is proposed to issue $1,200,000 4 per cent. waterworks bonds for improving the South Side system.

Jasper, Tenn.—A waterworks plant will be installed.

Houston, Tex.—An issue of $434,710 bonds has been voted to purchase a waterworks plant.

Elsinore, Utah.—Plans have been prepared by Jensen and McLaughlin for a waterworks system to cost $8,000.—H. H. Peterson, Member of Waterworks Commission.

Parsal, Mex.—A waterworks plant will be installed.

CONTRACTS TO BE AWARDED

Marianna, Ark.—Bids will be received, July 14, for laying 40,344 feet 8-inch and 694 feet 10-inch pipe.—Max D. Miller, Chairman, Board of Public Works.

Chicago, Ill.—Bids will be received, July 10, for building a chimney for the pumping station at Laurence avenue.—Wm. L. O'Connell, Commissioner of Public Works.

New Orleans, La.—Bids will be received, September 5, for erecting two water filtration plants, one of 40,000,000 gallons capacity, the other of 4,000,000 gallons capacity.—Sewerage and Water Board.

Braintree, Mass.—Bids were received, July 2, for furnishing and laying 8,600 feet of 8-inch water pipe, with hydrants, etc.—Board of Water Commissioners.

Whitefish, Mont.—Bids will be received, July 10, for constructing a waterworks plant to cost $25,000.—R. W. Rea, Engineer.

Leigh, Neb.—Bids will be received, July 9, for constructing a compressed-air system of waterworks.—R. J. McNary, Clerk.

Williston, N. D.—Bids were received, July 2, for all machinery, apparatus, materials, etc., for a waterworks and electric light plant.—W. H. Denny, Mayor; Geo. Cadogan Morgan, Chicago, Ill., Engineer.

Columbus, O.—Bids will be received, July 18, for constructing a waterworks pumping station and intake.—Henry Maetzel, Chief Engineer; E. F. McGuire, Secretary, Board Public Service.

Dayton, O.—Bids will be received, July 12, for $115,000 4 per cent. waterworks bonds.—Edward A. Phillips, City Auditor.

Tecumseh, Okla.—Bids were opened, July 2, for all material for constructing a waterworks and electric-light plant.—O'Neil Engineering Company, Dallas, Tex.; A. W. Asher, Mayor.

Warnette, Okla.—Bids will be received, July 5, for constructing a waterworks plant.—Geo. M. Southgate, Mayor.

Altoona, Pa.—Bids will be received, August 2, for constructing a storage reservoir on Burgoons river.—Board of Water Commissioners.

Philadelphia, Pa.—Bids will be received, July 5, for work under contract No. 53, including the cleaning of George's Hill Reservoir.—Thomas L. Hicks, Director, Department of Public Works.

Philadelphia, Pa.—Bids will be received, July 10, for constructing a 60,000,000-gallon daily capacity filtration plant at Queen Lane reservoir.—Cassius E. Gillette, Chief Engineer, Bureau of Filtration.

Manchester, Va.—Bids will be received, July 6, for $20,000 4 per cent. 34-year water filtration bonds.—J. W. Bronaugh, Jr., City Treasurer.

CONTRACTS AWARDED

Abia, Ia.—The contract for the waterworks system has been awarded W. D. Lovell & Co., Minneapolis, Minn.—C. A. Barthalow, Yale, Constructing Engineer.

Hawkeye, Ia.—The contract for installing a waterworks system has been awarded the Des Moines Bridge and Iron Works.

Ruston, La.—The contract for an artesian well has been let to L. B. Clifford Well Co., at $2,400.

Detroit, Mich.—The contract for rebuilding the dock at the pumping station has been awarded John Ginzel at $10,174.82.

Cincinnati, O.—The contract for laying 20 and 30-inch mains in Queen City avenue has been awarded Mullarkey & Underhill.—Edward Dempsey, Mayor.

Luray, Va.—The contract for 1,000 feet of 4-inch water main has been awarded E. P. Lillard.

Norfolk, Va.—The contract for furnishing and installing water main to Jamestown Exposition Grounds has been awarded to Wm. A. Young, at $61,444.70.

PUBLIC LIGHTING

Mobile, Ala.—A committee has been appointed to investigate the project of an electric-light plant.

Lompoc, Cal.—It is probable that an electric-light plant will be constructed.

Peoria, Ill.—The Peoria (Ill.) Light Company and the Evansville (Ind.) Light Company have been purchased by Hodenpyl, Walbridge and Company, of New York City. An issue of $1,000,000 improvement bonds will be made.

Independence, Mo.—An election will be held, July 2, to vote on the question of issuing $25,000 electric-light bonds.

Ironton, O.—It is recommended that a municipal lighting plant be installed.

Troy, O.—A bond issue has been voted for an electric-light plant.

Vale, Ore.—An election was held June 29, to decide the question of issuing electric-light bonds.

Bryan, Tex.—A franchise has been granted to Fritz Braatz to establish an electric-light and power plant.

Abbotsford, Mo.—It is probable that an electric-light plant will be built.—Louis Olson, Clerk.

PROPOSED WORK

Cartersville, Ga.—The citizens have voted to issue $25,000 municipal light bonds.

Dome, Ia.—A lighting plant will be installed.

Grand Junction, Ia.—The electric-light plant is to be remodeled and improved.—F. H. Richardson, Engineer.

Holton, Kan.—An issue of $25,000 electric-light bonds will be made.—S. H. Nowell, City Clerk.

Humboldt, Kan.—An electric-light system will be operated by V. G. Shinkle and others.

Appleton City, Mo.—It is proposed to issue $10,000 electric-light bonds.

Benedict, Neb.—An electric-light plant has been purchased and will be operated.

Fredonia, N. Y.—The electric-light plant will be rebuilt, at a cost of $10,000.

Ozona, Tex.—An electric-light plant will be installed.

Benwood, W. Va.—Plans are being prepared to establish a municipal lighting plant, to cost $30,000.

CONTRACTS TO BE AWARDED

Washington, D. C.—Bids will be received, July 10, for suppyling arc lamp globes, incandescent lamps, carbons, and electrical supplies for the Navy Yard at League Island.—Bureau of Supplies and Accounts.

Chicago, Ill.—Bids were received, July 3, for all material to be used for construction purposes in the Department of Electricity.—William Carroll, City Electrician, Room 12, City Hall.

Cleveland, O.—Bids will be received, July 6, for the superstructure of the Municipal Lighting Plant powerhouse.—A. R. Callow, Secretary, Board of Public Service.

CONTRACTS AWARDED

West Milwaukee, Wis.—The contract for street lighting has been awarded the Milwaukee Electric Railway and Lighting Company.

FIRE EQUIPMENT AND SUPPLIES

Hartford, Conn.—The Fire Commissioners have bought two Amoskeag engines at a cost of $7,450, and a combination hose wagon at a cost of $2,050.

Jersey City, N. J.—The Fire Board asks for an appropriation of $317,370 for expenses of Fire Department.

Jersey City, N. J.—An engine house and other improvements have been asked for the Seventh Ward.

Paterson, N. J.—It is recommended by Fire Chief Stagg that a second size engine, a combination chemical and hose wagon, and 2,000 feet of 3-inch hose, and 3,000 feet of 2 1-2-inch hose be purchased.

Bristol, R. I.—Plans are being made to improve the fire protection.

Fort Worth, Tex.—A site has been selected on Sixteenth street for the No. 3 fire engine company.

PROPOSED WORK

Wataga, Ill.—It has been voted to improve the fire protection.

Madison, Ind.—Bids will be advertised for building a fire cistern in North Jefferson street.

Lawrence, Mass.—It is proposed to erect an engine-house to cost $60,000.—Chas. G. Rutler, Chief.

Ann Arbor, Mich.—It is proposed to purchase fire apparatus.

Gladstone, Mich.—The Council proposes to purchase 500 feet of hose.

Omaha, Neb.—Bids are advertised for constructing an engine house at 24th and Cummings streets.

Cohoes, N. Y.—Two fire horses will be purchased.

Canton, O.—An expenditure of $30,000 will be made for erecting fire stations.—J. R. Fausett, President Board of Public Safety.

Shawnee, Okla.—Plans are being made for a fire station.

Tahlequah, Okla.—It is proposed to expend $4,000 for fire protection.

Hummelstown, Pa.—A chemical engine will be purchased.

Mitchell, S. D.—Bids have been advertised for a combined chemical and hose wagon.

Nekoosa, Wis.—An appropriation has been made for a hose reel and other fire apparatus.

CONTRACTS TO BE AWARDED

Rockford, Ill.—Bids will be received, July 16, for erecting West End fire station.

Newark, O.—Bids will be received, July 27, for $7,500 bonds for erecting and equipping a fire station.—Frank T. Muaratte, Auditor.

Memphis, Tenn.—Bids will be received, July 5, for erecting a two-story engine house in accordance with plans.—Ennis M. Douglas, City Register; Chighizola, Hanker & Cairns, Architects.

CONTRACTS AWARDED

Buffalo, N. Y.—The contract for a fire engine has been awarded the Ahrens' Fire Engine Company, Cincinnati, O.

Montreal, Que., Can.—The contract for the No. 5 Fire Station has been awarded P. Labelle at $15,900.—Fire Commissioners.

MUNICIPAL BUILDINGS

Greenwich, Conn.—The public building and grounds bill provides $20,000 for purchasing grounds.

New Britain, Conn.—The public building and grounds bill provides $140,000 for purchasing a building site.

Stamford, Conn.—An appropriation of $100,000 has been asked for school buildings.

De Funiak Springs, Fla.—The question of issuing school bonds will be submitted to a vote on July 24.

Norman Park, Ga.—An election will be held to vote on the question of issuing $15,000 school, waterworks and sewer bonds.

Aurora, Ill.—An election will be held, July 21, to decide the question of issuing bonds for erecting a high school.

Bar Harbor, Me.—The omnibus public building bill introduced by Chairman Bartholdt, House Committee, provides $60,000 for a public building.

Calais, Me.—The public building and grounds bill provides $60,000 to erect a building.

Portland, Me.—The public building and grounds bill provides $200,000 for a building.

Beverly, Mass.—The public building and grounds bill provides $18,000 to purchase a site.

Battle Lake, Minn.—The proposition to issue $15,000 school bonds was defeated.

Eupora, Miss.—An election will be held, August 10, to vote on the question of issuing $15,000 Courthouse bonds.

Amsterdam, N. Y.—The omnibus bill provides $20,000 for public building.

Canadaigua, N. Y.—Teh omnibus bill provides $75,000 for public buildings.

Corning, N. Y.—The omnibus bill provides $60,000 for public buildings.

Gloversville, N. Y.—The omnibus bill provides an appropriation of $6,000 for public buildings.

Hudson, N. Y.—The omnibus bill provides $75,000 for public buildings.

Ithaca, N. Y.—The omnibus bill provides $30,000 for public buildings.

Kingston, N. Y.—The omnibus bill provides $30,000 for public buildings.

Little Falls, N. Y.—The omnibus bill provides $35,000 for public buildings.

Olean, N. Y.—The omnibus bill provides $75,000 for public buildings.

Rome, N. Y.—The omnibus bill provides $7,000 for public buildings.

Schenectady, N. Y.—The omnibus bill provides $170,000 for public building.

Syracuse, N. Y.—The omnibus building bill provides $150,000 for public buildings and grounds.

Yonkers, N. Y.—The omnibus bill provides $200,000 for public buildings.

Parkersburg, W. Va.—An election will be held, July 10, to decide the question of issuing $15,000 school bonds.

PROPOSED WORK

Gadsden, Ala.—An issue of $15,000 school bonds has been voted.

Nashville, Ark.—Plans will be drawn by S. Stewart, Texarkana, for the school building to be erected.

Sandpoint, Ida.—A school building to cost $30,000 will be erected.—Geo. Williams, Cœur D'Alene, Architect.

Abilene, Kan.—An issue of $35,000 high school bonds has been voted.

Alpha, Minn.—A brick school building will be constructed.—Freeman D. Orff, Minneapolis, Architect.

Eupora, Miss.—It is proposed to erect a Courthouse to cost $15,000.

Higginsville, Mo.—An issue of $25,000 school bonds has been voted.

Scotia, N. Y.—It is proposed to erect a City Hall to cost $5,000.

Warren, O.—A hospital to cost $25,000 will be erected.

Boynton, Okla.—An issue of $10,000 school bonds has been voted.

Enid, Okla.—A school building to cost $20,000 will be constructed in the Fifth Ward.

Huntsville, Tex.—A school building to cost $21,000 will be erected.

Malone, Tex.—An issue of $7,000 school bonds has been voted.

Follansbee, W. Va.—An issue of $20,000 school bonds will be made.

CONTRACTS TO BE AWARDED

Beaufort, S. C.—Bids were received, July 2, for constructing a steel bridge.—W. F. Sanders, Superintendent, Beaufort County.

Jonesboro, Ark.—Bids will be received, July 18, for erecting a jail.—J. H. Burk, Chairman County Commissioners.

Colorado Springs, Col.—Bide were opened, June 28, for $20,000 4 1-2 per cent. school bonds.—O. E. Hemenway, Clerk.

Washington, D. C.—Bids will be received, July 10, for changes in the Lobby of the Inquiry Division and in the City and Mailing Divisions of the U. S. Postoffice.—James Knox Taylor, Supervising Architect.

Monticello, Ga.—Bids were opened, July 1, for painting, calcimining, etc., at various Chairman, Board of County Commissioners.

Chicago, Ill.—Bids were opened, July 2, for furnaces and grates required in the Cook County Courthouse to be erected.—William McLaren, Supt. Public Service.

Chicago, Ill.—Bids were opened, June 29, for painting, calsomining, etc., at various schools.—Commission on Buildings and Grounds, Board of Education.

Springfield, Ill.—Bids will be received, July 17, for constructing a Supreme Court building.—James A. Rose, Secretary of State.

Algona, Ia.—Bids were opened, July 2, for improving Bryant school.—L. E. Dodge, Secretary of School Board.

Wichita, Kan.—Bids will be received, August 1, for $40,000, 4 per cent., 20-year school bonds.—C. S. Caldwell, Secretary.

Whitesburg, Ky.—Bids will be received, July 6, for erecting a jail and jailer's residence.—H. T. Day, Commissioner; A. J. Sturgill, Clerk.

Boston, Mass.—Bids were opened, June 28, for installing heating and ventilating system in extension to Mechanics Arts high school, Scotia street.—R. Clipston Sturgis, Charles Logue and Thomas Mullen, Commissioners.

St. Paul, Minn.—Bids will be received, July 7, for furnishing school supplies.—Robert A. Smith, Mayor; Henry Haas, President of Council; Otto Bemer, City Treasurer.

Macon, Miss.—Bids were received, July 3, for erecting a jail in Noxuboe county.—Z. T. Doroh, Chancery Clerk.

Meridian, Miss.—Bids were received, July 3, for $35,000 4½ per cent. 30-year school bonds.—T. R. McElroy, City Clerk.

Philadelphia, Miss.—Bids will be received, July 5, for $15,000, 5 per cent., 20-year school bonds.—R. L. Breland, Clerk.

Gilliam, Mo.—Bids will be received, June 30, for erecting a schoolhouse.—W. T. Swinney, President Board of Education; R. H. Land, Clerk.

Jersey City, N. J.—Bids will be received, July 12, for improving grounds surrounding the high school building.—Fred Ege, Secretary, Board of Education.

Potsdam, N. Y.—Bids will be received, July 9, for constructing State Normal school.—G. L. Heins, State Architect, Albany, N. Y.

Schenectady, N. Y.—Bids will be received, July 17, for $110,000, 4 per cent. school bonds.—O. S. Luffman, Comptroller.

CONTRACTS AWARDED

Blytheville, Ark.—The contract for the jail has been awarded the Southern Construction Company, at $7,500.—T. J. Mahan, W. O. Gravette and W. A. Hollipeter, Jail Commissioners.

Noblesville, Ind.—The contract for the school building has been awarded to Aaron Spaumuth and Noah Earl, at $23,579.

Beverley, Mass.—The contract for the high school has been let to J. W. Duff, Auburndale, for $80,000.

Springfield, Mo.—The contract for a school building has been awarded W. H. Hilbuck, at $15,874.

Hoboken, N. J.—The contract for constructing school 9 has been awarded as follows: Mason work, Calumet Construction Co., $118,873; carpenter work, Robert J. Roth, $29,200; heating and ventilating, American Heating and Ventilating Company, $19,722.—Eugene Ciccarelli, Architect.

Middletown, N. Y.—The contract for electrical work at the State Hospital has been let to the Premier Electrical Company, for $5,000.—State Commission on Lunacy.

BRIDGES

Chicago, Ill.—A plan is under way to connect North and South Sides by changing Central Court into a boulevard, connecting Grant Park with Pine street, and this will be a new bascule bridge over the river, at a total cost of $1,000,000.—William Rest, Park Commissioner; Daniel F. Cailley, South Park Commissioner.

Springfield, Mo.—The Booneville street bridge will be improved, and not rebuilt.

Lorain, O.—A bridge over Black River, south of Lorain, is asked for.

Westminster, S. C.—It is probable that a bridge will be constructed over Little river near Burnt Tanyard.—L. H. V. Holson, County Supervisor.

Manchester, Va.—An ordinance is before Council providing for an issue of $250,000, 4 per cent., 50-year bridge bonds.

Norfolk, Va.—Plans for the Elizabeth River Railway bridge have been forwarded to the War Department for approval.—Major E. E. Winslow, U. S. Engineer's office.

Tacoma, Wash.—A petition for a steel bridge across the Puyallup River, at Schoenboechler road, has been presented by H. J. Manny and others.

Morgantown, W. Va.—An election will be held to decide the question of issuing $50,000 Monongahela county bridge bonds.

Milwaukee, Wis.—It is recommended that $23,000 be taken from the bridge construction fund for repairs on various bridges.

PROPOSED WORK

Texarkana, Ark.—Two bridges will be built, at a cost of $2,070.56.

Texarkana, Ark.—It is proposed to build a steel and concrete viaduct over the yards of the Iron Mountain Railway, at a cost of $35,000.

Denver, Col.—Plans are being prepared to build a viaduct at Tenth street.

Florence, Col.—Steel bridge will be constructed over Wilson Creek, at a cost of $2,000.

Washington, D. C.—Bill has been passed authorizing a bridge to be built across the Sunflower, in Mississippi.

Washington, D. C.—The construction of a bridge across the Ohio, from Wheeling Island, W. Va., to the Ohio shore, has been authorized.

Washington, D. C.—A bill has been passed, authorizing the Georgia, Florida and Alabama Railway Company to build three bridges across the Chattahoochie river, one near Eufaula, Ala., and two near Columbus, Ga.

Jacksonville, Fla.—A number of bridges will be repaired.—Chairman, Roads and Bridges Committee.

Morrison, Ill.—About $7,000 will be expended on bridge repairs, and a bridge will be erected across Elkhorn creek.

Peoria, Ill.—A bridge will be built over Little Mackinaw river on the Hopedale road, at a cost of $2,000.

Quincy, Ill.—Bids are advertised for constructing a steel bridge across Light's creek, Deadfall lane; also a steel bridge across Long Valley creek, Quartz road district.

Rockford, Ill.—Bids will be received for a bridge over Kent creek.—S. B. Hand, Engineer.

Sterling, Ill.—Bids will be received for building a bridge at G avenue.—Roy R. Baer, Clerk.

Jennings, La.—A steel bridge will be built across Bayou Nexpique, to replace the bridge destroyed by fire.

Mitchell, S. D.—A bridge will be constructed across Firesteel creek.—Davison County Commissioners.

Goliad, Tex.—A bridge will be constructed across the Blanco creek, Bee county to pay one-third the cost.

Norfolk, Va.—An appropriation of $1,100 has been made for a fender for the York street bridge.

Basin, Wyo.—Several bridges in Big Horn County will be rebuilt.

CONTRACTS TO BE AWARDED

Aspen, Col.—Bids were opened, June 29, for constructing a 61-foot span on Ten Mile bridge over Bearing Fork river.—R. M. Ryan, Clerk, County Commissioners.

Golden, Col.—Bids were opened, June 30, for two steel bridges.—W. H. Light, Chairman.

Danville, Ill.—Bids were opened, June 21, for constructing a bridge across Stony creek at Buchanan street.—J. Torrance, City Clerk.

Sycamore, Ill.—Bids will be received, about August 15, for constructing a steel and concrete bridge, to cost $5,000.—E. L. Spring, City Clerk, W. H. Hay, Engineer.

Troy, Ill.—Bids will be received, July 2, for constructing a brick or concrete culvert.—Henry Stolte, Mayor.

South Bend, Ind.—Bids were received, July 2, for constructing four concrete culverts in Penn township.—John W. Harlon, Auditor.

Bemidji, Minn.—Bids will be received, July 9, for constructing a wagon bridge across Gull river, according to plans.—A. W. Danaher, Chairman County Board; John Wilmann, County Auditor.

St. Paul, Minn.—Bids were opened, June 18, for a pipe culvert with concrete ends on Bald Eagle lake, opposite Block 2, Ramsey county.—Edward G. Krahmer, County Auditor.

STREET RAILWAYS

Huntingburg, Ind.—An electric line will probably be built to Ferdinand.—Matthew Olinger, Sr., is interested.

Washington, D. C.—It is recommended by Commissioner Cameron Forbes, Manila, P. I., that the bid of Speyer & Co. for constructing a railway in the Philippines be accepted.

PROPOSED WORK

Windsor Locks, Conn.—An electric power station will be erected by the Northern Connecticut Light and Power Company.

Chicago, Ill.—Acceptance for the trolleyizing ordinance by the Union Traction Company has been tendered the City Clerk.

Indianapolis, Ind.—About sixty miles of electric line will be constructed by the Indianapolis, Huntington, Columbia City and Northwestern Railway Company; capital, $1,500,000.—Benj. Raupfer, President.

Towson, Md.—An electric line will be built to Lutherville by the United Railways and Electric Company.

Hibbings, Mich. — Franchise has been granted the Northern Traction Company to build a line in several streets.—Robert F. Berdie, Representative.

Albany, N. Y.—An electric line will be constructed from the terminus of the United Traction Company on Western avenue to a point west of Allen street.

New York, N. Y.—A four-track extension will be built by the Brooklyn Rapid Transit Company, to Bensonhurst, Bath Beach and Coney Island, to be part subway and part surface, with a loop terminal at Coney Island.

Cincinnati, O.—An electric line will be built to Hillsboro, by the Hillsboro, Bellfast and Peebles Traction Company.—P. M. Hughes, Lovett, President.

Cleveland, O.—An electric line extending to the Lake Shore electric line and connecting western Ohio, will be built.

Dayton, O.—A city line, comprising about 11 miles of track, will be built by a company headed by Ralph E. De Weese, formerly identified with the Dayton and Northern Traction Company.

Kenton, O.—It is proposed to build an electric line to Lima and Marion, provided Kenton raises $25,000 for the project.

Springfield, O.—The Springfield Railway Company will extend its lines on West Pleasant street.

CONTRACTS AWARDED

Indianapolis, Ind.—The contract for sixty miles of electric line from Goshen and Huntington has been awarded M. V. Ryan, of Silver Creek, N. Y., by the Indianapolis, Huntington, Columbia City and Northwestern Railway Company.

Rochester, N. Y.—The contract for electrification of the Rochester division of the Erie Railway Company, between Mount Morris and Rochester, was awarded Westinghouse, Church, Kerr and Company.

GARBAGE AND WASTE DISPOSAL

Cincinnati, O.—The Board of Public Service is about to ask Council to issue bonds to purchase the plant of the Cincinnati Reduction Company.—Edward A. Dempsey, Mayor.

POLICE

Dayton, O.—The Board of Public Safety has petitioned for an appropriation of $15,000 for the purpose of placing the police and fire service wires under ground.

Wheeling, W. Va.—An appropriation of $5,000 has been asked for a police signal and call system.

WANTS

INSPECTOR.—Of construction; understands brick, stone, reinforced-concrete, steel frame, bridge and dam construction; engage with engineer, architect or owner; first-class reference. KEY, EDWARD LYNCH, Mamaroneck, N. Y.

WANTED.—Sewerage Engineer and Constructor. Expert in designing systems and in construction work. Man willing to assume responsibility and invest capital (not less than ($5,000), can establish a good connection with a fully organized Sewage Disposal Company, having in hand good work, with future business secured. No agents. Address "Partner," Municipal Journal.

Proposals

Notice to Sewer and Paving Contractors

Fort Smith, Arkansas.

Sealed proposals will be received by the Board of Improvement for Sewer District No. 2 and Paving District No. 5, at their office in Fort Smith, Arkansas, until 2 o'clock P. M. July 18, 1906, for furnishing the necessary labor and materials to construct storm and sanitary sewers in said Sewer District No. 2, and also to construct the brick pavement for said Paving District No. 5.

Said work and improvement to be made in accordance with plans, profiles and specifications therefor, which will be on file and ready for inspection at the office of said Board on and after July 1st.

The approximate quantities of the work upon which bids will be considered are as follows:

Brick Pavement .....650,000 Square Yards

Concrete or brick sewer:

11'-9" to 8'-6" in size	8,300	lineal ft.
8'-0" to 6'-6" "	6,000	" "
6'-0" to 3'-0" "	22,000	" "

Vitrified pipe:

36" to 6" "	180,000	" "

All necessary manholes, flush tanks, lampholes, and catch basins.

Separate proposals must be submitted for the sewer and paving work. Bids for each improvement must be accompanied by a certified check for the sum of $5,000, made payable to said Board of Improvement, as guarantee that the bidder will, within ten days after the acceptance of his proposal, enter into contract and furnish satisfactory bond for the completion of the work.

The right to reject any or all bids, or to accept any bid, is reserved by said Board of Improvement.

All bidders are advised that a deposit of shale suitable for making paving brick and vitrified sewer pipe is available within the City Limits, that there is also a cheap fuel for burning same and that it is the purpose of the Board of Improvement to allow sufficient time for the erection of plant to manufacture the brick and sewer pipe.

HARRY E. KELLEY,
Chairman of Board of Improvement.